Grading Permit
No. 4710

SOILS INVESTIGATION
KAOPA SUBDIVISION UNIT 2
KAILUA, OAHU, HAWAII
W.O. 192 - JULY 8, 1970

GEOLABS-HAWAII, INC.
1553 COLBURN STREET, SUITE 203
HONOLULU, HAWAII 96817

GEOLABS-HAWAII, Inc.
Geology, Soils and Foundation Engineering
1553 Colburn Street, Suite 203 • Honolulu, Hawaii 96817 • (808) 841-5064

August 17, 1970

W. O. 192

Island Construction
1020-E Keolu Drive
Kailua, Hawaii 96734

Attention: Mr. Melvin Hardy

Subject: Addendum
Kaopa Subdivision - Unit 2
Kailua, Oahu, Hawaii

Gentlemen:

With regard to the treatment of the soft clay material for this area, the clay must be removed as recommended. The excavated clay shall be dried and/or dewatered to its optimum moisture content.

Upon drying of the clay material, the clay may be reused as on-site fill with the boulders. The clay shall be placed between the boulders in each layer and rolled and compacted to the required compaction per the earthwork specifications and data sheet 79G (F.H.A.).

The large rock (less than 3 ft. diameter) and clay may be used in the fill to within 2 feet of finished rough grade. The upper 2 feet shall consist of on-site soils with no rocks in excess of 6 inches in diameter. The work,as included in this addendum and the original report,shall be accomplished under the supervision of the soils engineer.

The foregoing recommendations will apply to Area #2 as included in the original report dated July 8, 1970 with specific reference to Paragraphs 1) a and b, page 10, W. O. 192.

Very truly yours,
GEOLABS-HAWAII, INC.

Stanley N. Mitchell

Stanley N. Mitchell, P.E.

STANLEY N. MITCHELL
REGISTERED
PROFESSIONAL
ENGINEER
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HAWAII, U.S.A.

Ronald A. Pickering
Vice President

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A. Unified Soil Classification System

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B. Laboratory Test Results

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D. Unconfined Compression Test Curve

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G. Gravel Specifications for School Site Area

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Site Plan - Figure #1

GEOLABS-HAWAII, Inc.
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1553 Colburn Street, Suite 203 • Honolulu, Hawaii 96817 • (808) 841-5064

July 8, 1970

W. O. 192

Island Construction
1020-E Keolu Drive
Kailua, Hawaii 96734

Attention: Mr. Melvin Hardy

Subject: Soils Investigation
Kaopa Subdivision - Unit 2
Kailua, Oahu, Hawaii

Gentlemen:

The following report presents the results and recommendations of a soils investigation completed at the proposed Kaopa Subdivision Unit 2 in Kailua, Oahu, Hawaii. A site plan showing the area covered by this investigation is enclosed as Figure #1.

SUMMARY OF SOIL CONDITIONS

1. The site can be divided into four (4) soil types:

   a) Deeply weathered basaltic rocks exposed as reddish brown soils in the ridges along the west side of the tract.

   b) Deeply weathered basaltic rocks exposed as light

brown soils in the ridges along the north side of the tract.

c) Soft, gray CLAY with some peat overlying Finger CORAL found in the swamp area near the lake.

d) Medium to stiff, red or brown soils overlying soft clays found along the base of the hills.

2. On the basis of these soil types, the site can be subdivided into three areas as they relate to foundation conditions. These areas have been designated Area 1, 2 and 3 as shown on Figure #1.

3. Area No. 1 - Soil Types 1-a and 1-b

The soils are somewhat expansive and special precaution will be needed for foundation design. No settlement problems are anticipated. Backslopes can be designed with 1½:1 slopes. If excessive subsurface moisture is encountered, special slope treatment will be required. Slopes shall be properly drained and planted.

4. Area No. 2 - Soil Type 1-c

Most of this area is in the swamp that lies adjacent to the lake and is underlain by 4 to 6 feet of soft clay

and some peat. The upper four feet of soft material will need to be removed and replaced with granular material compacted to 90% (AASHO T-180-57).

Settlement will be a problem in this area. Settlement platforms will need to be installed and monitored. At least a 5-foot surcharge fill will need to be placed over the compacted granular fill and left in place until most of the settlement has taken place.

5. Area No. 3 - Soil Type 1-d

This area lies along the base of the hills where approximately 4 feet of medium to stiff clay overlies more than six feet of soft compressible clay. Foundation loads shall not exceed 800 PSF.

6. Water was encountered in the test pits in the low area and in the drill holes near the base of the hills generally at or near the lake elevation.

SITE DESCRIPTION

The area covered by this investigation consists of approximately 40 acres located in the Enchanted Lakes area in Kailua, Oahu, Hawaii. The area is bounded on the west and north by hills

that rise over 200 feet with slopes ranging from 1½:1 to 5:1 above the general terrain. These hills are covered with brush and a scattering of trees. The low area, near the lake, slopes gradually from lake elevation to the base of the hills 5 to 10 feet above. Most of the low area lies in a swamp that has been partially filled along the Keolu Drive extension. The swamp area is covered with swamp grass and a scattering of brush and trees. Water lies at or near the surface. Between the swamp and the hills, the ground surface is irregular with sections that are heavily covered with trees.

FIELD EXPLORATION

Ten (10) drill holes were drilled on the site to depths of 10 to 25 feet. The drill holes were advanced using a Mobile Minuteman auger drilling rig with 3-inch diameter flight augers. Undisturbed samples were obtained at various depths using a 1.4 inch I.D. standard sampler driven with a 140-lb hammer having a 30-inch free fall. In addition, four (4) test pits were excavated in the low area using a dragline. Undisturbed samples were obtained using a drive tube sample spoon with a 2.8 inch I.D. Also representative samples were obtained during the field exploration for laboratory tests. The soil material encountered in the test holes and test pits does not necessarily

represent subsurface conditions at other points on the site; however, sampling procedures are believed to be representative. The soil material was classified visually in the field and representative undisturbed and disturbed samples were returned to the laboratory for a more detailed analyses.

LABORATORY TESTS

Representative samples were analyzed in the laboratory to determine classification of the material in accordance with the Unified Soil Classification System. Consolidation tests, direct shear, unconfined compression, unit weight, moisture content, laboratory maximum density and C.B.R. tests were performed on the soil material derived from the site.

Direct shear tests were run on one sample of soft clay containing some peat. The resulting 24 degree friction angle is probably due to roots and organic inclusions and the true friction angle is nearer 0^{o} (zero degrees).

Direct shear tests on the stiff, red-brown Clayey SILT indicate 6 degree friction angle with 5,920 PSF cohesion.

Moisture content was determined for most of the samples. The stiff to very stiff Clayey SILT exposed in the hills averaged

25% while the compressible clay in the swamp area ran from 28% to 136%.

Atterberg Limit Tests were performed which indicated the stiff clayey soils generally fall into the MH soil classification while the soft clayey soils fall into the OH-MH soil classification. Hydrometer analysis tests were performed to determine the percentage of sand, silt and clay. The stiff, red clayey soils are subject to less than 6 percent expansion while the soft, gray soils were not critical with respect to expansion properties.

Laboratory test results are presented in summary form in the appropriate spaces on the drilling logs and in the appendices which are included with this report. A discussion of the field and laboratory tests and the recommendations as derived therefrom are included in the following section.

DISCUSSION

The results of field observations, drill holes, pit excavations and laboratory tests indicate four general soil types exist at subject site. The site has been divided into three areas based upon anticipated foundation conditions. See Figure #1 for location.

Area 1 - This area lies along the west and north sides of the site where the hills rise over 200 feet above the general terrain. The soils exposed in the ridges represent highly weathered basalts. The proposed 2:1 fill slopes and 1½:1 cut slopes with 8-foot wide benches at 12 feet vertical intervals are satisfactory as shown in Section A and Section C on grading plan dated May 4, 1970 prepared for this project. The slopes will need to be planted to prevent erosion and the benches sloped to drain. Cut slopes will rise 140 feet in one area.

Area 2 - This area includes much of the swamp adjacent to the lake and has been set aside for a school site. Portions of this area were recently filled with 2 to 4 feet of clayey gravel in the vicinity of Keolu Drive extension in connection with the construction of the sewer line. Most of the area is underlain with 4 to 6 feet or more of soft clay containing some peat. Grass and a scattering of brush and trees cover the area and water lies at or near the surface.

It is recommended that the upper 4 feet of soft clay and organic matter be removed from the site. This material will need to be replaced with granular material compacted to 90% (AASHO T-180-57). The plans show 10 to 20 feet of fill for

this area and settlement is anticipated. See next section for recommendations.

Area 3 - This area lies between the hills and the low swamp where the ground surface is irregular and sections are covered with a thick growth of trees. Two to four feet of medium to stiff clay overlies soft, compressible clay.

RECOMMENDATIONS

I. Area 1

1. All cut slopes shall be at 1½:1 or flatter with 8-foot wide benches at vertical intervals of 12 feet as shown on grading plans prepared for this project dated May 4, 1970. In the northeast section there is a small area where rock may be encountered and the slope ratio can be 1:1.

2. Where the deep cuts occur on the existing hillsides, it is anticipated that the depth of the cuts may extend deeper than the depths drilled for this investigation. The soils engineer shall verify the soil material occurring at the bottom of the cut for an additional depth of 10 feet. The soils engineer will review the material encountered in conjunction with the FHA requirements. If the additional drilling

is necessary, it shall be accomplished after the cut has been reached or when the excavation has reached the depths drilled for this report.

3. Seepage may occur in the hillside area trending from the hills toward Enchanted Lake. At the time the cuts are completed, an evaluation should be made by the soils engineer to determine if subdrains are required to remove the seepage water.

4. Providing the recommendations and earthwork specifications as included in this report are followed, the foundation soil material in Area 1 will be capable of supporting a total loading of 1,000 PSF.

5. Footings for the proposed residential houses should be placed no closer than 10 feet to the face of any slope. This may require deepening the footings in some areas.

6. With the exception of the rock area, the bottom of all footings in Area 1 shall be at a minimum depth of -18 inches from finished rough grade.

7. Where footings will occur in in-place rock material, the foundation may be designed for 2,000 PSF.

II. Area 2

1. Although the school site area is not considered a part of the subdivision, the following recommendations should be followed for preparing the swamp area:

a. The area shall be cleared of all vegetation, trees, etc. and removed from the site. The upper 4 feet of soft organic-clay shall be excavated and removed from the site.

b. A manufactured gravel shall then be placed into the cleared area. No rocks in excess of 12 inches in diameter shall be placed in the fill. The gravel shall be processed and compacted in accordance with the enclosed earthwork specifications.

SEE ADDENDUM

c. The fill shall be continued until the proposed finished rough grade for the adjacent street is reached. After the fill has been completed, settlement monuments shall be placed throughout the school site area such that a record can be made of the effect of the surcharge placed on the underlying, soft, compressible soils.

d. It will then be necessary, upon final completion of the plans for the school, that an additional soils

investigation be completed to determine the best foundation type for the school buildings.

e. To prevent sliding of the cut and fill material into the swamp area, it will be necessary that the swamp area, which is the school site area, be cleared of all vegetation and filled with the gravel material to the street elevation prior to the general earthwork operations for the subdivision.

III. Area 3

1. Area 3 is the transition area between the swamp and the hillside. The slopes as shown in Section C on the grading plans prepared for this project dated May 4, 1970 shall be followed. The slope ratio shall be modified for the cut slopes at a 1½:1 ratio and any fill slopes that may be necessary at 2:1 slope ratio. The 1:1 ratio as shown on Section C of the grading plan was based on the assumption that rock occurred in the area.

2. All of the site in Area 3 should be cleared and grubbed in accordance with the enclosed earthwork specifications.

3. After the area has been cleared and grubbed, the

existing ground surface should be scarified, watered, and compacted for a depth of 6 inches in accordance with the earthwork specification. Also all fill materials shall be processed and compacted per the earthwork specifications.

4. If the foregoing recommendations are followed, the foundation soil material will be capable of supporting a total loading of 800 PSF.

GENERAL RECOMMENDATIONS FOR ALL AREAS

1. In all areas, the footings for the residential structures should be placed no closer than 10 feet to the face of any slope. The foregoing may require deepening of some footings.

2. All slopes should be planted and maintained as soon as practicable.

3. All earthwork, including cut and fill operations, shall be accomplished in accordance with the enclosed earthwork specifications.

4. Should material be encountered that is different than that which is included and reported in this investigation, the soils

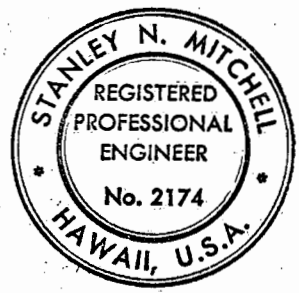
engineer shall perform additional laboratory tests to verify the assumptions included in this report and in accordance with FHA requirements.

This opportunity to be of service is appreciated.

Very truly yours,

GEOLABS-HAWAII, INC.

Stanley N. Mitchell, P.E.



Ronald A. Pickering
Vice President

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES
COARSE GRAINED SOILS (More than 50% material is larger than No. 200 Sieve Size)	GRAVELS (More than 50% of coarse fraction is larger than No. 4 Sieve size)	CLEAN GRAVELS (Little or no fines)	GW	Well graded gravels, gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels, gravel sand mixtures, little or no fines
		GRAVELS WITH FINES (Appreciable amt. of fines)	GM	Silty gravels, gravel-sand-silt mixtures
			GC	Clayey gravels, gravel-sand-clay mixtures
	SANDS (More than 50% of coarse fraction is smaller than No. 4 Sieve size)	CLEAN SANDS (Little or no fines)	SW	Well graded sands, gravelly sands, little or no fines
			SP	Poorly graded sands, gravelly sands, little or no fines
		SANDS WITH FINES (Appreciable amt. of fines)	SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures
FINE GRAINED SOILS (More than 50% material is smaller than No. 200 Sieve size)	SILTS AND CLAYS Liquid Limit less than 50%		ML	Inorganic silts & very fine sands, rock flour, silty or clayey fine sands, clayey silts with slight plasticity
			CL	Inorganic clays of low to medium plasticity, gravelly clays, silty clays, lean clays
			OL	Organic silts & organic silty clays of low plasticity
	SILTS AND CLAYS Liquid Limit Greater than 50%		MH	Inorganic silts, micaceous and diatomaceous fine sandy or silty soils, elastic silts.
			CH	Inorganic clay of high plasticity, fat clays
			OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS			Pt	Peat and other highly organic soils

PARTICLE SIZE LIMITS

GRAVEL		SAND			SILT	CLAY
Coarse	Fine	Coarse	Medium	Fine		

3in 3/4in. No.4 No.10 No.40 No.200 .074mm .005 mm

U.S. STANDARD SIEVE SIZE

GEOLABS-HAWAII, INC.

1553 COLBURN ST., HONOLULU, H. I. TEL. 815-064

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SUBSURFACE EXPLORATION & PENETRATION LOG

Work Order No. 192 Ground Elevation 8 Hole Number 1

Project Kaopa Subdivision Unit 2 Location See Figure 1

Total Depth of Hole 10 Elevation of Watertable 7.0 Date W L. Gaged 6-1-70

Weight of Hammer ____ Height of Drop ____ Date Begun 6-1-70

Hole Logged By L. Larson Foreman ____ Date Finished 6-1-70

Notes	Depth (Ft.)	No Blows	% Moisture	Samples	Description Unified Soil Classification	Depth (Ft.)	Log	Unit Wt. Lbs/Ft.3 (wet)	Phi O Value	Liquid Limit	Plastic Index
	1			1-1	Soft, brown Silty CLAY with small rocks, very moist. GC-ML	1					
	2					2				46	14
	3				Soft, gray Silty CLAY with some peat. OH	3					
	4					4					
	5					5					
	6					6					
	7				▽	7					
	8					8					
	9				Gray, Finger CORAL, shells and Silty SAND.	9					
	10					10					
	11				Bottom of Pit 10.0 feet	11					
	12					12					
	13					13					
	14					14					
	15					15					
	16					16					
	17					17					
	18					18					
	19					19					
	20					20					

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SUBSURFACE EXPLORATION & PENETRATION LOG

Work Order No. 192 Ground Elevation 12 Hole Number 2

Project Kaopa Subdivision Unit 2 Location See Figure 1

Total Depth of Hole 10 Elevation of Watertable N/E* Date W L. Gaged

Weight of Hammer Height of Drop Date Begun 6-2-70

Hole Logged By L. Larson Foreman Date Finished 6-2-70

Notes	Depth (Ft.)	No Blows	% Moisture	Samples	Description Unified Soil Classification	Depth (Ft.)	Log	Unit Wt. Lbs./Ft.^{3} (wet)	Phi O Value	Liquid Limit	Plastic Index
	1				Stiff, reddish brown Clayey SILT. Moist MH	1					
	2					2					
	3					3					
	4					4					
	5					5					
	6					6					
	7					7					
	8					8					
	9					9					
	10					10					
	11				Bottom of Pit 10.0 feet	11					
	12					12					
	13					13					
	14					14					
	15					15					
	16					16					
	17					17					
	18					18					
	19					19					
	20					20					

* N/E = Not Encountered

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SUBSURFACE EXPLORATION & PENETRATION LOG

Work Order No. 192 Ground Elevation 45 Hole Number 3

Project Kaopa Subdivision Unit 2 Location See Figure 1

Total Depth of Hole 15.0 Elevation of Watertable N/E* Date W.L. Gaged

Weight of Hammer 140-lb Height of Drop 30" Date Begun 6-1-70

Hole Logged By L. Larson Foreman Date Finished 6-1-70

Notes	Depth (Ft.)	No Blows	% Moisture	Samples	Description Unified Soil Classification	Depth (Ft.)	Log	Unit Wt. Lbs/Ft.3 (wet)	Phi O Value	Liquid Limit	Plastic Index
	1				Stiff, brown Clayey SILT. Moist MH	1					
	2					2					
	3	5				3					
	4	7				4					
	5	6				5					
	6					6					
	7					7					
	8		28		Very stiff, brown Clayey SILT. MH	8					
	9	8				9					
	10	12	32			10					
	11	12				11					
	12					12					
	13					13					
	14					14					
	15		31			15					
	16				Bottom of Pit 15.0 feet	16					
	17					17					
	18					18					
	19					19					
	20					20					

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SUBSURFACE EXPLORATION & PENETRATION LOG

Work Order No. 192 Ground Elevation 75' Hole Number 4

Project Kaopa Subdivision Unit 2 Location See Figure 1

Total Depth of Hole 25 Elevation of Watertable N/E* Date W L. Gaged

Weight of Hammer Height of Drop Date Begun 6-3-70

Hole Logged By L. Larson Foreman Date Finished 6-3-70

Notes	Depth (Ft.)	No Blows	% Moisture	Samples	Description Unified Soil Classification	Depth (Ft.)	Log	Unit Wt. Lbs/Ft.3 (Wet)	Phi O Value	Liquid Limit	Plastic Index
	1		16		Stiff, light brown Clayey SILT. Moist. MH	1					
			27	4-1						68	29
	2					2					
	3					3					
	4					4					
	5					5					
	6					6					
	7					7					
	8					8					
	9					9					
	10					10					
	11					11					
	12					12					
	13					13					
	14					14					
	15		26	4-2		15					
	16					16					
	17					17					
	18					18					
	19					19					
	20					0					

CONT'D.

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SUBSURFACE EXPLORATION & PENETRATION LOG

Work Order No. 192 Ground Elevation 75' Hole Number 4
Project Kaopa Subdivision Unit 2 Location See Figure 1
Total Depth of Hole 25 Elevation of Watertable N/E* Date W.L. Gaged
Weight of Hammer Height of Drop Date Begun 6-3-70
Hole Logged By L. Larson Foreman Date Finished 6-3-70

Notes	Depth (Ft.)	No Blows	% Moisture	Samples	Description Unified Soil Classification	Depth (Ft.)	Log	Unit Wt. Lbs/Ft.3 (Wet)	Phi O Value	Liquid Limit	Plastic Index
	1				Stiff, light brown Clayey SILT. Moist. MH	1					
	2					2					
	3					3					
	4					4					
	5					5					
	6				Bottom of Pit 25.0 feet	6					
	7					7					
	8					8					
	9					9					
	10					10					
	11					11					
	12					12					
	13					13					
	14					14					
	15					15					
	16					16					
	17					17					
	18					18					
	19					19					
	20					20					

*N/E = Not Encountered

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SUBSURFACE EXPLORATION & PENETRATION LOG

Work Order No. 192 Ground Elevation 25' Hole Number 5

Project Kaopa Subdivision Unit 2 Location See Figure 1

Total Depth of Hole 10.5 Elevation of Watertable N/E* Date W L. Gaged

Weight of Hammer 140-lb Height of Drop 30" Date Begun 6-3-70

Hole Logged By L. Larson Foreman Date Finished 6-3-70

Notes	Depth (Ft.)	No Blows	% Moisture	Samples	Description Unified Soil Classification	Depth (Ft.)	Log	Unit Wt. Lbs/Ft.3 (Wet)	Phi O Value	Liquid Limit	Plastic Index
	1				Stiff, light brown Clayey SILT with orange streaks. MH	1					
	2					2					
	3	5				3					
	4	15	17	5-1	Very stiff, light brown Clayey SILT. MH	4					
	5	25				5					
	6					6					
	7					7					
	8					8					
	9					9					
	10	5				10					
	11	17				11					
	12	25			Bottom of Pit 10.5 feet	12					
	13					13					
	14					14					
	15					15					
	16					16					
	17					17					
	18					18					
	19					19					
	20					20					

*N/E = Not Encountered

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SUBSURFACE EXPLORATION & PENETRATION LOG

Work Order No. 192 Ground Elevation 50' Hole Number 6

Project Kaopa Subdivision Unit 2 Location See Figure 1

Total Depth of Hole 4.0' Elevation of Watertable N/E* Date W.L. Gaged

Weight of Hammer Height of Drop Date Begun 6-3-70

Hole Logged By L. Larson Foreman Date Finished 6-3-70

Notes	Depth (Ft.)	No Blows	% Moisture	Samples	Description Unified Soil Classification	Depth (Ft.)	Log	Unit Wt. Lbs/Ft.3 (Wet)	Phi O Value	Liquid Limit	Plastic Index
	1				Stiff, reddish brown Clayey SILT. Moist MH	1					
	2					2					
	3		28	16-1	Stiff, light brown Clayey SILT. Moist MH	3					
Refusal	4					4					
	5				Bottom of Pit 4.0 feet	5					
	6					6					
	7					7					
	8					8					
	9					9					
	10					10					
	11					11					
	12					12					
	13					13					
	14					14					
	15					15					
	16					16					
	17					17					
	18					18					
	19					19					
	20					20					

*N/E = Not Encountered

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SUBSURFACE EXPLORATION & PENETRATION LOG

Work Order No. 192 Ground Elevation 8.0 Hole Number 7

Project Kaopa Subdivision Unit 2 Location See Figure 1

Total Depth of Hole 10.0' Elevation of Watertable 7.0' Date W L. Gaged 6-3-70

Weight of Hammer ____ Height of Drop ____ Date Begun 6-3-70

Hole Logged By L. Larson Foreman ____ Date Finished 6-3-70

Notes	Depth (Ft.)	No Blows	% Moisture	Samples	Description Unified Soil Classification	Depth (Ft.)	Log	Unit Wt. Lbs./Ft.^{3} (wet)	Phi O Value	Liquid Limit	Plastic Index
					Soft, brown Silty CLAY.						
	1					1					
	2				Soft, blue gray CLAY with	2					
				17-1	Peat.						
	3				CH, Pt	3		100.0		104	68
	4					4					
	5					5					
	6					6					
	7				Gray, FINGER CORAL, shells	7					
	8				and Silty SAND.	8					
	9					9					
	10					10					
	11				Bottom of Pit 10.0 feet	11					
	12					12					
	13					13					
	14					14					
	15					15					
	16					16					
	17					17					
	18					18					
	19					19					
	20					0					

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SUBSURFACE EXPLORATION & PENETRATION LOG

Work Order No. 192 Ground Elevation 4.0' Hole Number 8

Project Kaopa Subdivision Unit 2 Location See Figure 1

Total Depth of Hole 10.0 Elevation of Watertable 1.0 Date W.L. Gaged 6-3-70

Weight of Hammer ____ Height of Drop ____ Date Begun 6-3-70

Hole Logged By L. Larson Foreman ____ Date Finished 6-3-70

Notes	Depth (Ft.)	No Blows	% Moisture	Samples	Description Unified Soil Classification	Depth (Ft.)	Log	Unit Wt. Lbs/Ft.3 (wet)	Phi O Value	Liquid Limit	Plastic Index
	1		140	18-1	Soft, blue gray CLAY with peat. CL-Pt	1		113.9	0°		
	2					2					
	3					3					
	4					4					
	5				Gray, FINGER CORAL, shells and Silty SAND.	5					
	6					6					
	7					7					
	8					8					
	9				Bottom of Pit 10.0 feet	9					
	10					10					
	11					11					
	12					12					
	13					13					
	14					14					
	15					15					
	16					16					
	17					17					
	18					18					
	19					19					
	20					20					

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SUBSURFACE EXPLORATION & PENETRATION LOG

Work Order No. 192 Ground Elevation 15 Hole Number 9

Project Kaopa Subdivision Unit 2 Location See Figure 1

Total Depth of Hole 10 Elevation of Watertable N/E* Date W L. Gaged

Weight of Hammer Height of Drop Date Begun 6-3-70

Hole Logged By L. Larson Foreman Date Finished 6-3-70

Notes	Depth (Ft.)	No Blows	% Moisture	Samples	Description Unified Soil Classification	Depth (Ft.)	Log	Unit Wt. Lbs./Ft.3 (Wet)	Phi O Value	Liquid Limit	Plastic Index
	1				Stiff, reddish brown Silty CLAY. Moist. MH-CH	1					
	2					2					
	3		35	10-1		3					
	4				Soft, brown CLAY. Wet CH	4					
	5					5					
	6		45	10-2	Soft, light brown CLAY. Wet.	6					
	7					7					
	8		55	10-3		8					
	9					9					
	10					10					
	11				Bottom of Pit 10.0 feet	11					
	12					12					
	13					13					
	14					14					
	15					15					
	16					16					
	17					17					
	18					18					
	19					19					
	20					20					

*N/E = Not Encountered

—GEOLABS, INC.—

SUBSURFACE EXPLORATION & PENETRATION LOG

Work Order No. 192 Ground Elevation 135' Hole Number 10
Project Kaopa Subdivision Unit 2 Location See Figure 1
Total Depth of Hole 30' Elevation of Watertable N/E* Date W.L. Gaged
Weight of Hammer Height of Drop Date Begun 6-2-70
Hole Logged By L. Larson Foreman Date Finished 6-2-70

Notes	Depth (Ft.)	No Blows	% Moisture	Samples	Description Unified Soil Classification	Depth (Ft.)	Log	Unit Wt. Lbs/Ft.3 (Wet)	Phi O Value	Liquid Limit	Plastic Index
	1				Stiff, red Clayey SILT. Moist. MH	1					
	2					2					
	3					3					
	4					4					
	5					5					
	6					6					
	7					7					
	8					8					
	9					9					
	10					10					
	11					11					
	12					12					
	13					13					
	14					14					
	15					15					
	16					16					
	17					17					
	18					18					
	19					19					
	20					20					

Continued

—GEOLABS, INC.—

SUBSURFACE EXPLORATION & PENETRATION LOG

Work Order No. 192 Ground Elevation 135' Hole Number 10

Project Kaopa Subdivision Unit 2 Location See Figure 1

Total Depth of Hole 30' Elevation of Watertable N/E Date W L. Gaged ____

Weight of Hammer ____ Height of Drop ____ Date Begun 6-2-70

Hole Logged By L. Larson Foreman ____ Date Finished 6-2-70

Notes	Depth (Ft.)	No Blows	% Moisture	Samples	Description Unified Soil Classification	Depth (Ft.)	Log	Unit Wt. Lbs./Ft.3 (wet)	Phi O Value	Liquid Limit	Plastic Index
	1				Stiff, red Clayey SILT. Moist. MH	1					
	2					2					
	3			10-1		3					
	4					4					
	5					5					
	6					6					
	7					7					
	8					8					
	9					9					
	10					10					
	11				Bottom of Pit 30.0 feet	11					
	12					12					
	13					13					
	14					14					
	15					15					
	16					16					
	17					17					
	18					18					
	19					19					
	20					20					

* Not Encountered

GEO-24

—GEOLABS, INC.—

SUBSURFACE EXPLORATION & PENETRATION LOG

Work Order No. 192 Ground Elevation 50' Hole Number 11
Project Kaopa Subdivision Unit 2 Location See Figure 1
Total Depth of Hole 10' Elevation of Watertable N/E* Date W L. Gaged
Weight of Hammer Height of Drop Date Begun 6-3-70
Hole Logged By L. Larson Foreman Date Finished 6-3-70

Notes	Depth (Ft.)	No Blows	% Moisture	Samples	Description Unified Soil Classification	Depth (Ft.)	Log	Unit Wt. Lbs/Ft.3 (wet)	Phi O Value	Liquid Limit	Plastic Index
	1				Stiff, red Clayey SILT. Moist. MH	1					
	2					2					
	3		22	12-1		3					
	4					4		108.9	6°		
	5					5					
	6					6					
	7					7					
	8					8					
	9					9					
	10					10					
	11				Bottom of Pit 10.0 feet	11					
	12					12					
	13					13					
	14					14					
	15					15					
	16					16					
	17					17					
	18					18					
	19					19					
	20					20					

*N/E = Not Encountered

—GEOLABS, INC.—

SUBSURFACE EXPLORATION & PENETRATION LOG

Work Order No. 192 Ground Elevation 60' Hole Number 12

Project Kaopa Subdivision Unit 2 Location See Figure 1

Total Depth of Hole 15' Elevation of Watertable N/E Date W L. Gaged

Weight of Hammer 140-lb Height of Drop 30" Date Begun 6-2-70

Hole Logged By L. Larson Foreman Date Finished 6-2-70

Notes	Depth (Ft.)	No Blows	% Moisture	Samples	Description Unified Soil Classification	Depth (Ft.)	Log	Unit Wt. Lbs/Ft.3 (wet)	Phi O Value	Liquid Limit	Plastic Index
	1				Stiff, red Clayey SILT. Moist. MH	1					
	2					2					
	3	5	21	13-1		3					
	4	8				4					
	5	15				5					
	6					6					
	7					7					
	8					8					
	9					9					
	10	4				10					
		9	29	13-2							
		14									
	11				Very stiff, tan Clayey SILT. Moist. MH	11					
	12					12					
	13					13					
	14					14					
	15					15					
	16				Bottom of Pit 15.0 feet	16					
	17					17					
	18					18					
	19					19					
	20					20					

*N/E = Not Encountered

GEO-24

—GEOLABS, INC.—

SUBSURFACE EXPLORATION & PENETRATION LOG

Work Order No. 192 Ground Elevation 18 Hole Number 13

Project Kaopa Subdivision Unit 2 Location See Figure 1

Total Depth of Hole 10.0' Elevation of Watertable 8.5 Date W L. Gaged 6-2-70

Weight of Hammer ____ Height of Drop ____ Date Begun 6-2-70

Hole Logged By L. Larson Foreman ____ Date Finished 6-2-70

Notes	Depth (Ft.)	No Blows	% Moisture	Samples	Description Unified Soil Classification	Depth (Ft.)	Log	Unit Wt. Lbs/Ft.3 (wet)	Phi O Value	Liquid Limit	Plastic Index
	1				Medium, red Silty CLAY. Moist. MH	1					
	2			14-1		2				57	5
	3					3					
	4		36	14-2	Soft, red Silty CLAY.	4					
	5		43	14-3	Soft, gray CLAY with some organic material. CH-OH	5					
	6					6					
	7					7					
	8				▽	8					
	9					9					
	10					10					
	11				Bottom of Pit 10.0 feet	11					
	12					12					
	13					13					
	14					14					
	15					15					
	16					16					
	17					17					
	18					18					
	19					19					
	20					20					

—GEOLABS, INC.—

SUBSURFACE EXPLORATION & PENETRATION LOG

Work Order No. 192 Ground Elevation 25 Hole Number 14

Project Kaopa Subdivision Unit 2 Location See Figure 1

Total Depth of Hole 10.0 Elevation of Watertable 4.5 Date W L. Gaged 6-2-70

Weight of Hammer ____ Height of Drop ____ Date Begun 6-2-70

Hole Logged By L. Larson Foreman ____ Date Finished 6-2-70

Notes	Depth (Ft.)	No Blows	% Moisture	Samples	Description Unified Soil Classification	Depth (Ft.)	Log	Unit Wt. Lbs/Ft.3 (wet)	Phi O Value	Liquid Limit	Plastic Index
	1				Stiff, reddish brown Clayey SILT. Moist. MH	1					
	2					2					
	3		27	15-1		3					
	4				▽	4					
	5				Medium, reddish brown Clayey SILT. Very moist. MH	5					
	6					6					
	7					7					
	8					8					
	9					9					
	10		32	15-2		10					
	11				Bottom of Pit 10.0 feet	11					
	12					12					
	13					13					
	14					14					
	15					15					
	16					16					
	17					17					
	18					18					
	19					19					
	20					20					

LABORATORY TEST RESULTS

Project: Kaopo Subdivision #2 W. O. No. 192

Drill Hole No.	1	4	7	8	11	12
Depth (ft.)	-1	-1	-2	-1	-3	-3
Hydrometer Tests						
% Sand	35	12	13			
% Silt	33	29	36			
% Clay	32	59	51			
Atterberg Limit Tests						
Liquid Limit (%)	46	68	104			
Plastic Limit (%)	32	39	36			
Plastic Index	14	29	68			
USCS	ML	MH	CH			
Specific Gravity						
Unconf. Str. (PSF)						15,900
Proctor						
Max Dry Unit Wt (PCF)	105.0	101.5				
Optimum Water (%)	21.5	20.5				
Expansion (@100 PSF)						
Natural (%)			0.0%		+ 6.28%	
Remolded (%) (85%; Wc+)						
In-Place γ wet (PCF)			100.0	113.9	108.9	132.2
In-Place Wc (%)		27.4	65.7	140.0	21.5	29.6
CBR						
Sample γ dry (PCF)	95.2	95.5				
Sample Wc %	21.5	20.5				
% Expansion	+ 5.2%	6.0%				
CBR @ 0.1" Penet.	5.3	4.5%				

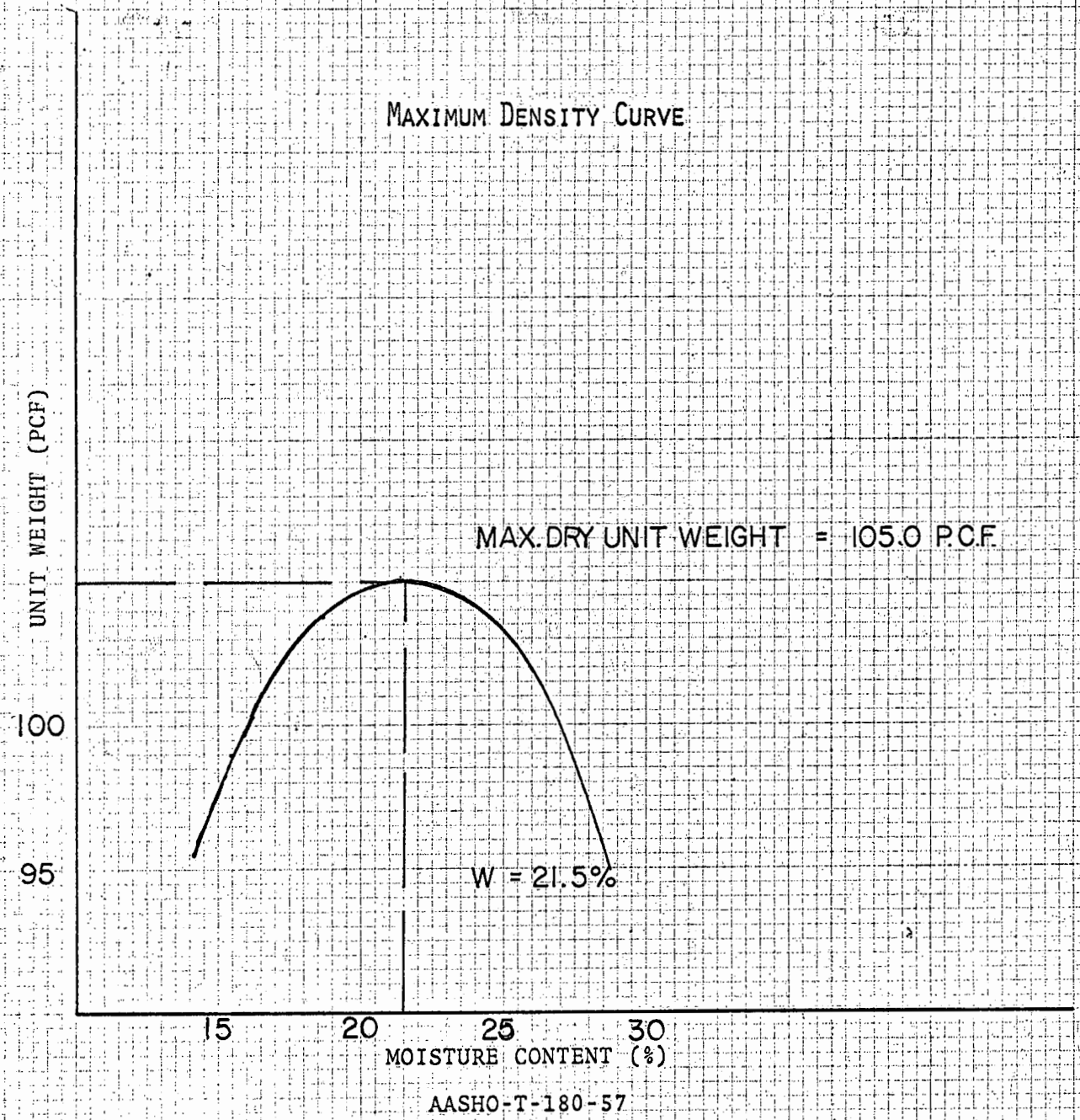
LABORATORY TEST RESULTS

Project: Kaopo Subdivision #2 W. O. No. 192

Drill Hole No.	12	13				
Depth (ft.)	-9	-1.5				
Hydrometer Tests						
% Sand		27				
% Silt		15				
% Clay		58				
Atterberg Limit Tests						
Liquid Limit (%)		57				
Plastic Limit (%)		52				
Plastic Index		5				
USCS		MH				
Specific Gravity						
Unconf. Str. (PSF)	8,750					
Proctor						
Max Dry Unit Wt (PCF)		98.0				
Optimum Water (%)		25.0				
Expansion (@100 PSF)						
Natural (%)						
Remolded (%) (85%; Wc+)						
In-Place γ wet (PCF)	114.4					
In-Place Wc (%)	28.6					
CBR						
Sample γ dry (PCF)		93.8				
Sample Wc %		25.0				
% Expansion		+ 3.4%				
CBR @ 0.1" Penet.		3.0%				

GEOLABS-HAWAII, INC.

MAXIMUM DENSITY CURVE



AASHO-T-180-57

SAMPLE LOCATION: DH #1

SAMPLE DEPTH: -1.0'

SOIL CLASS: ML

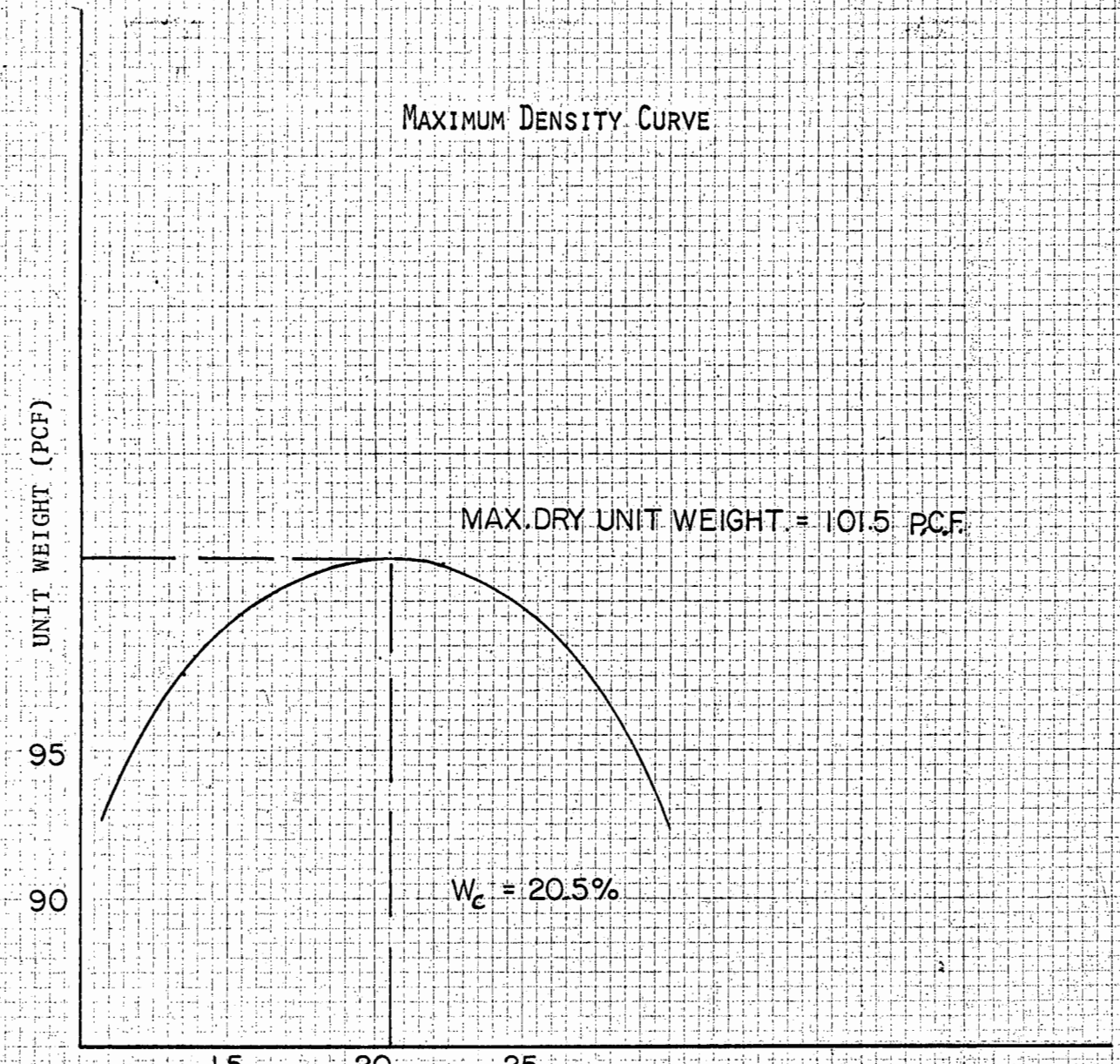
W.O. NO. 192

CLIENT: H.P.I.

DATE: 6-25-70

GEOLABS-HAWAII, INC.

MAXIMUM DENSITY CURVE



AASHO-T-180-57

SAMPLE LOCATION: DH #4

SAMPLE DEPTH: — 1.0

SOIL CLASS: MH

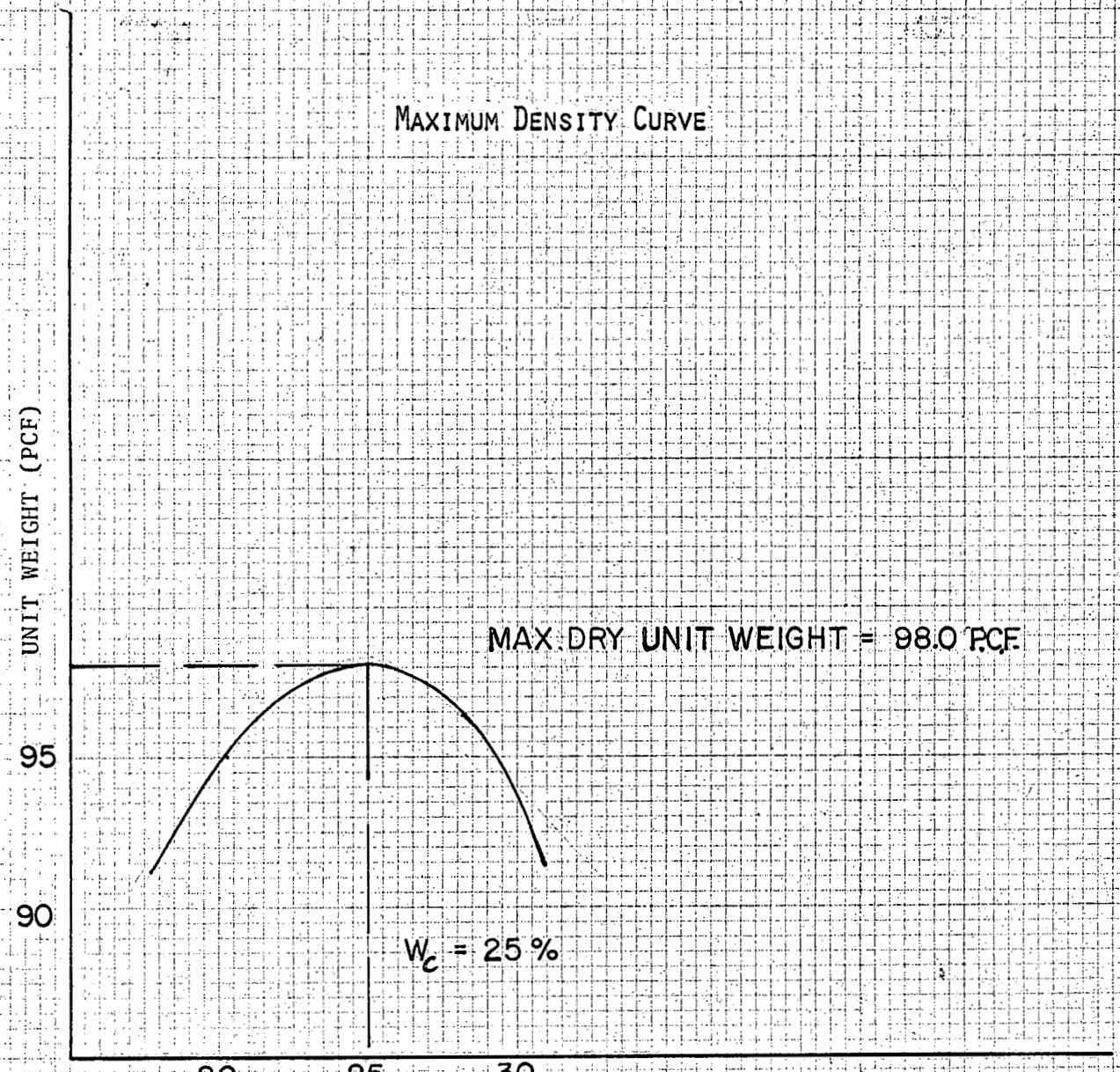
W.O. NO. 192

CLIENT: H.P.I.

DATE: 6-25-70

GEOLABS-HAWAII, INC.

MAXIMUM DENSITY CURVE



AASHO-T-180-57

SAMPLE LOCATION: DH. #13

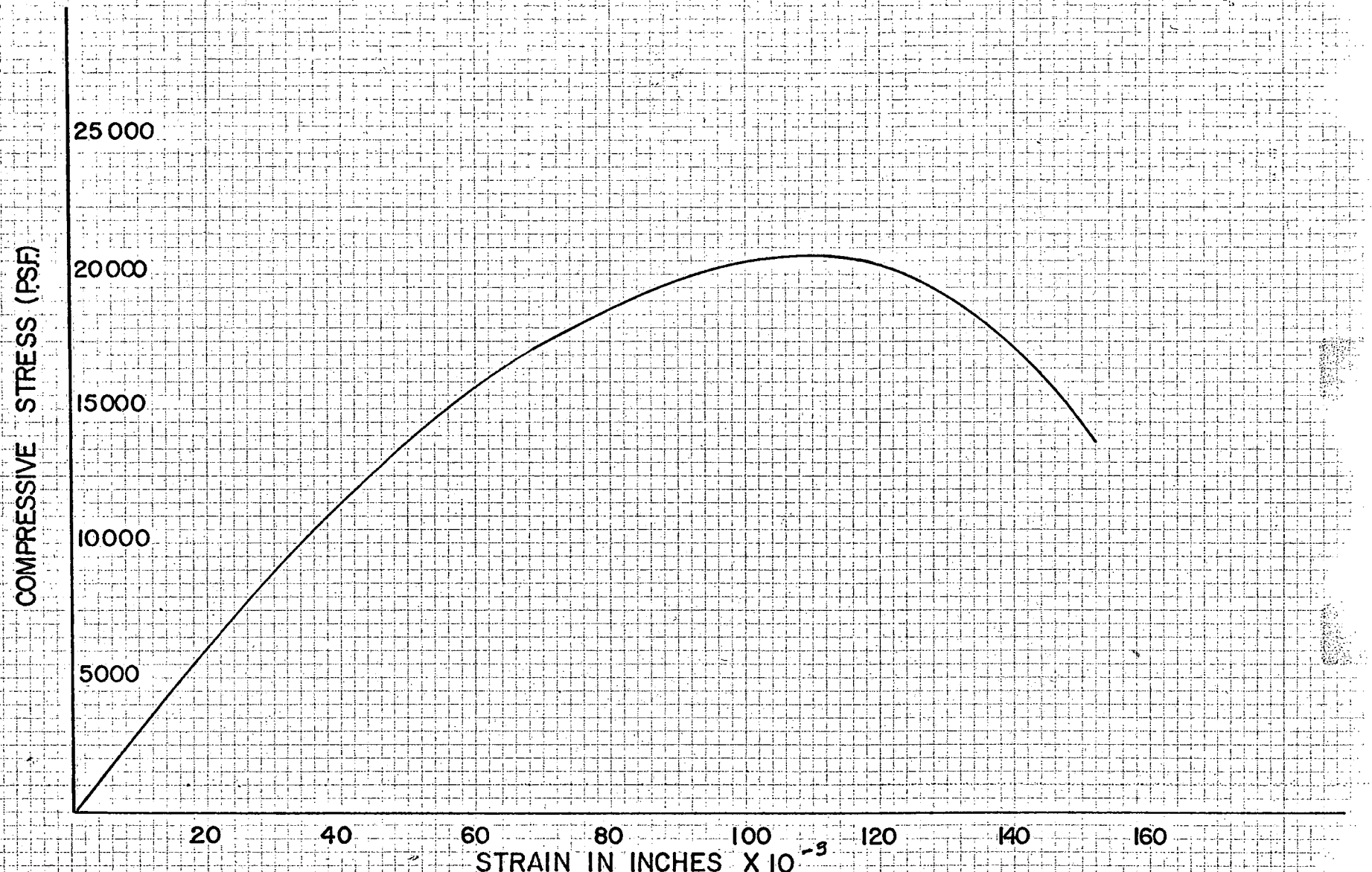
SAMPLE DEPTH: — 1.5'

SOIL CLASS: MH.

W.O. NO. 192

CLIENT: HPI

DATE: 6-25-70



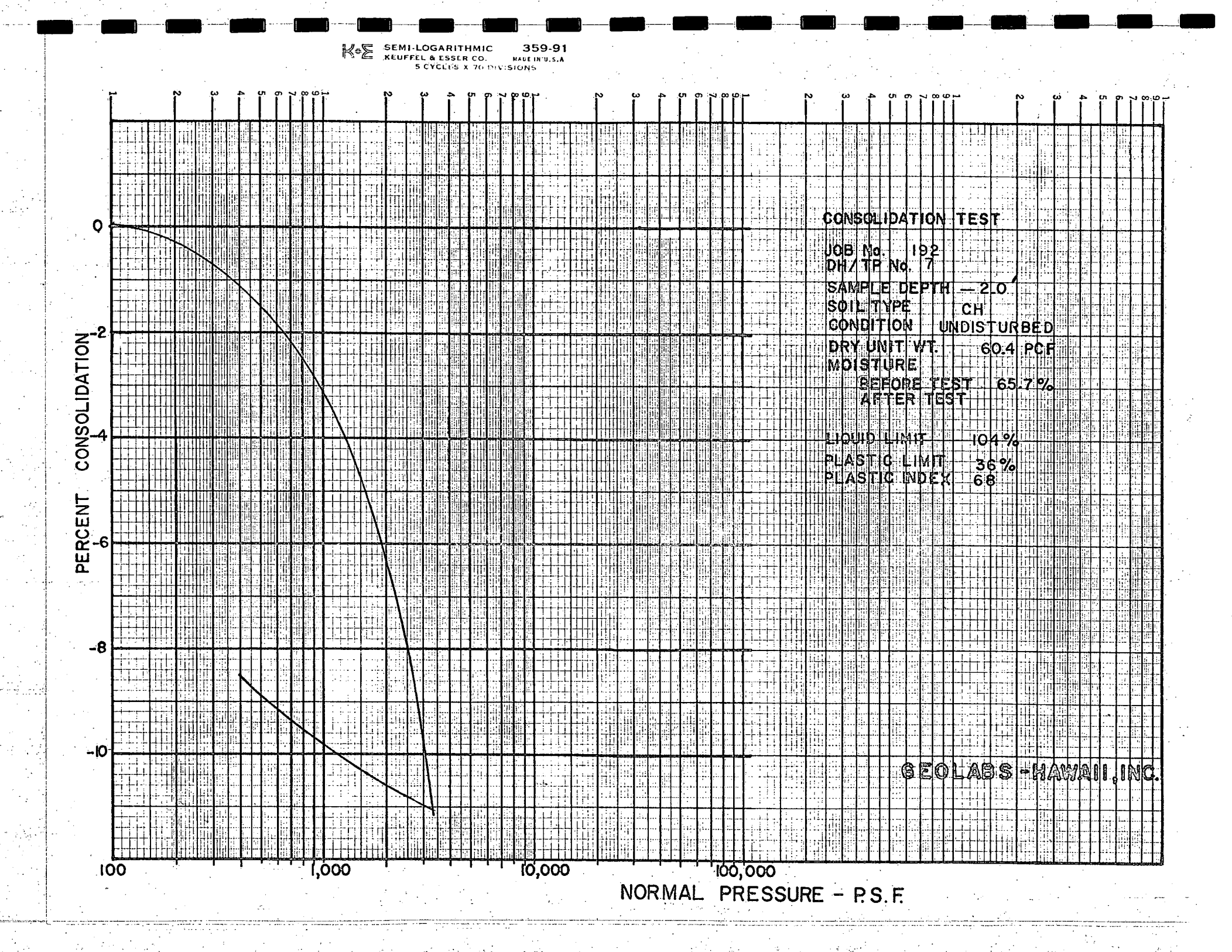
UNDISTURBED SAMPLE : RED CLAYEY SILT (MH)

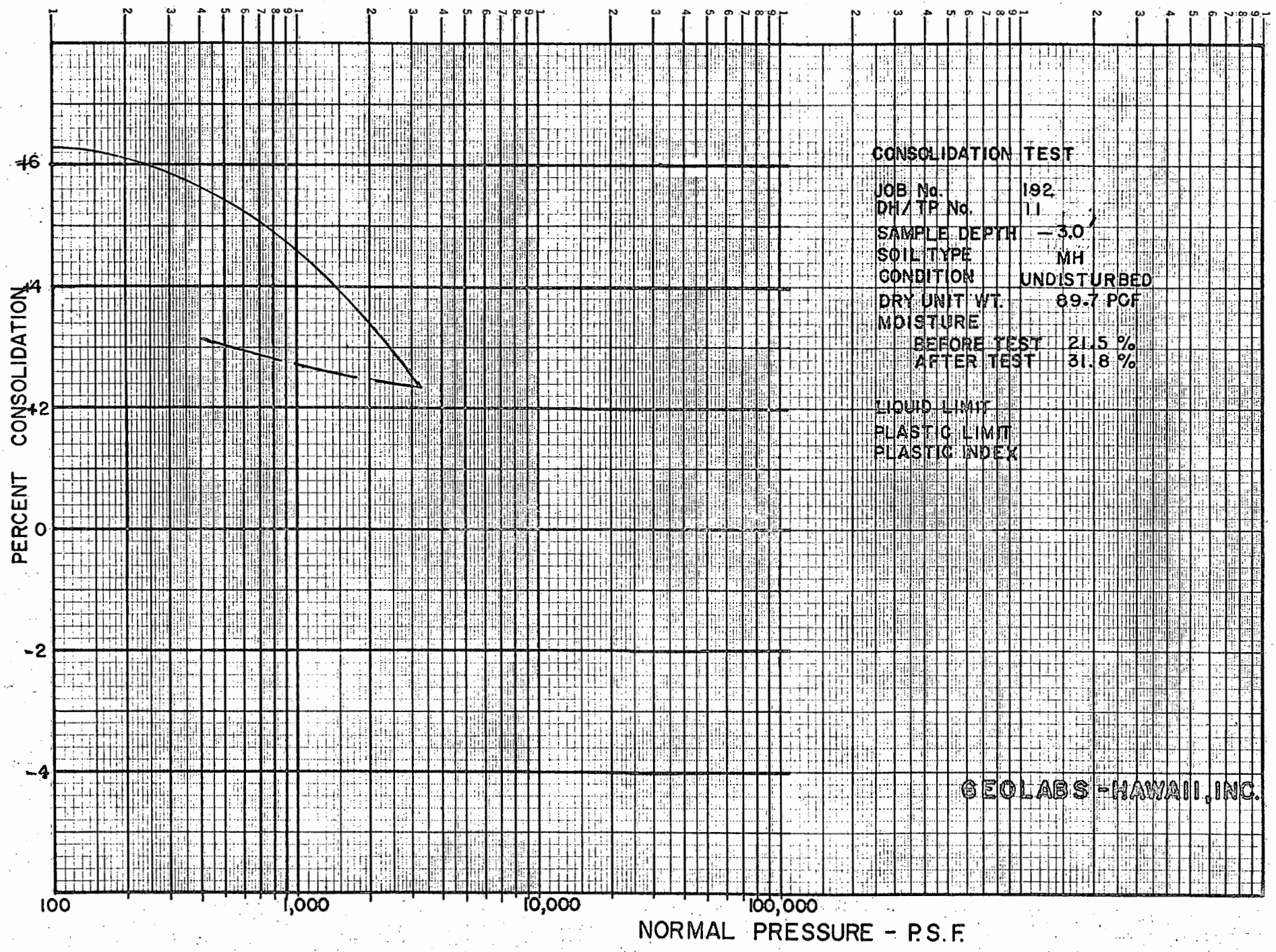
γ WET = 132.2 P.C.F.

W_c = 29.6%

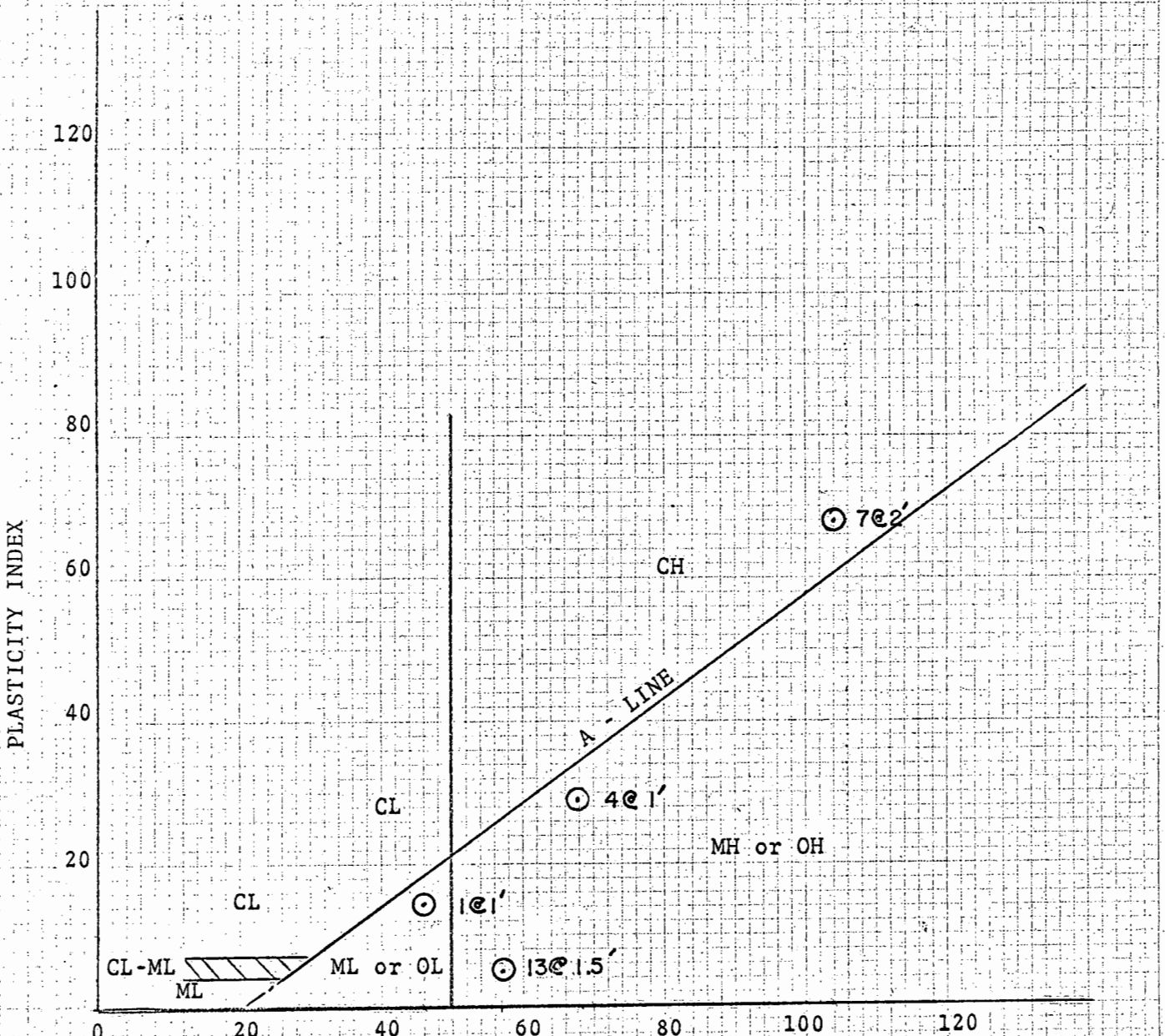
W.O. 192

TP 12 @ -3.0'


K+E SEMI-LOGARITHMIC 359-91
KEUFFEL & ESSER CO. MADE IN U.S.A.
5 CYCLES X 70 DIVISIONS
CONSOLIDATION TEST
JOB No. 192
DH/TP No. 7
SAMPLE DEPTH — 2.0'
SOIL TYPE CH
CONDITION UNDISTURBED
DRY UNIT WT. 60.4 PCF
MOISTURE
BEFORE TEST 65.7 %
AFTER TEST
LIQUID LIMIT 104 %
PLASTIC LIMIT 36 %
PLASTIC INDEX 68
GEOLABS - HAWAII, INC.
PERCENT CONSOLIDATION
0
-2
-4
-6
-8
-10
100
1,000
10,000
100,000
NORMAL PRESSURE - P.S.F.



GEOLABS-HAWAII, INC.



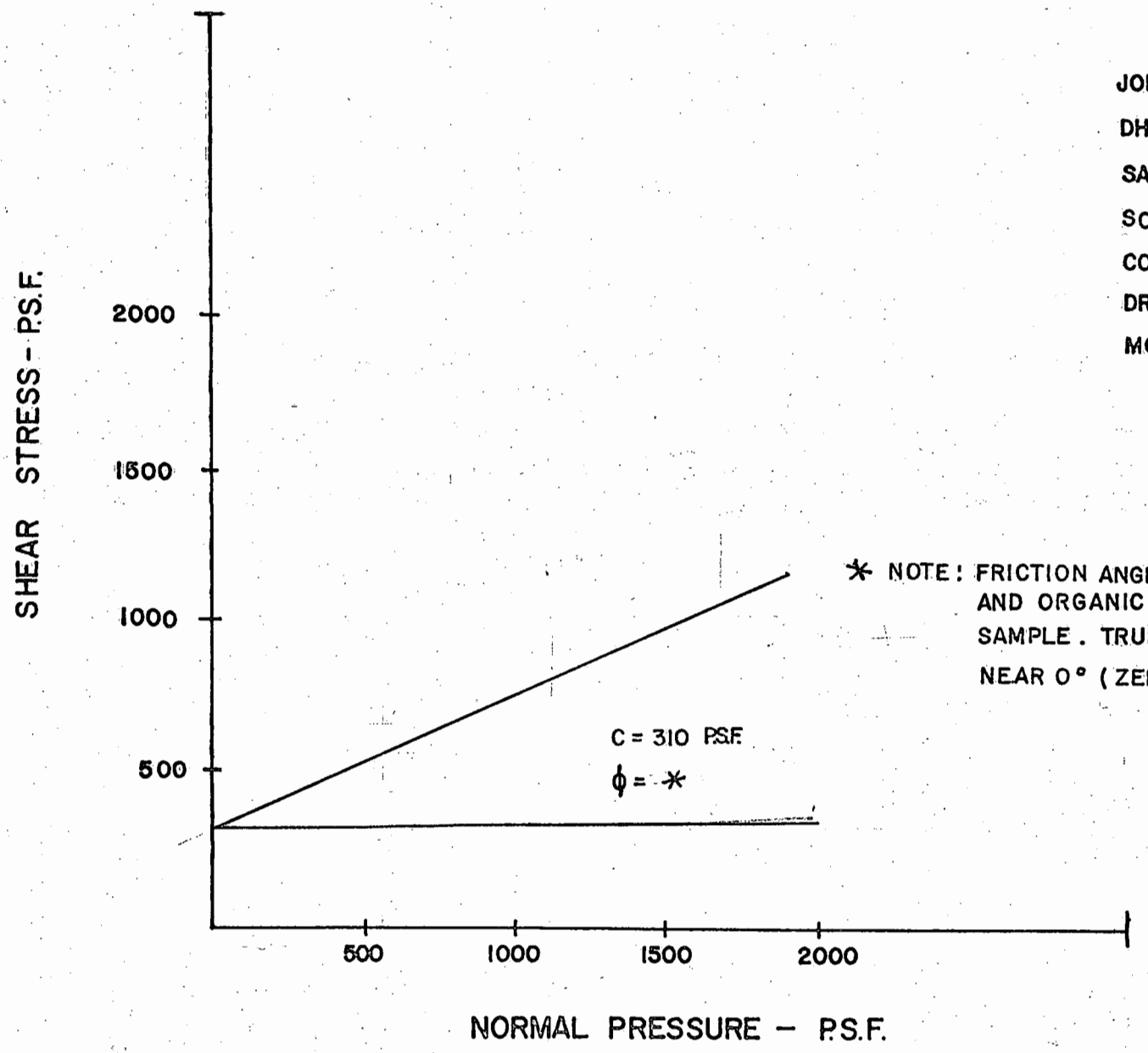
PLASTICITY CHART

Project: KAOPO #2 W.O. 192

Date: 6-10-70

DIRECT SHEAR TEST

JOB No. 192
DH/TP No. 8
SAMPLE DEPTH ± 1.0'
SOIL TYPE CL - P.T.
CONDITION UNDISTURBED
DRY UNIT WT. 47.4 PCF
MOISTURE 140.0 %



* NOTE: FRICTION ANGLE DUE TO ROOTS AND ORGANIC INCLUSIONS IN SAMPLE. TRUE FRICTION ANGLE NEAR 0° (ZERO DEGREES)

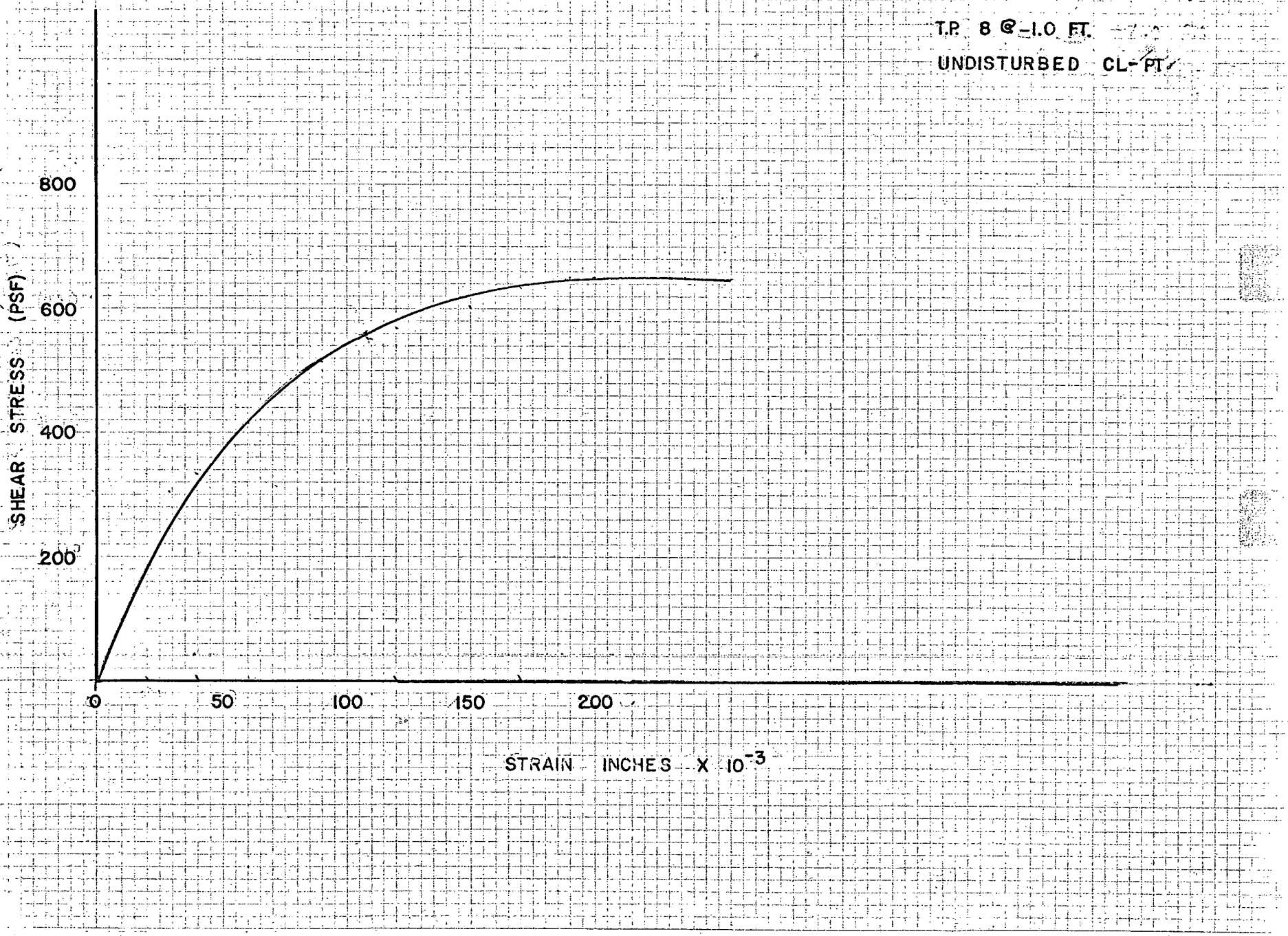
PT-1

DIRECT SHEAR TEST

NORMAL LOAD = 550 PSF

T.P. 8 @ -1.0 FT.

UNDISTURBED CL-PT



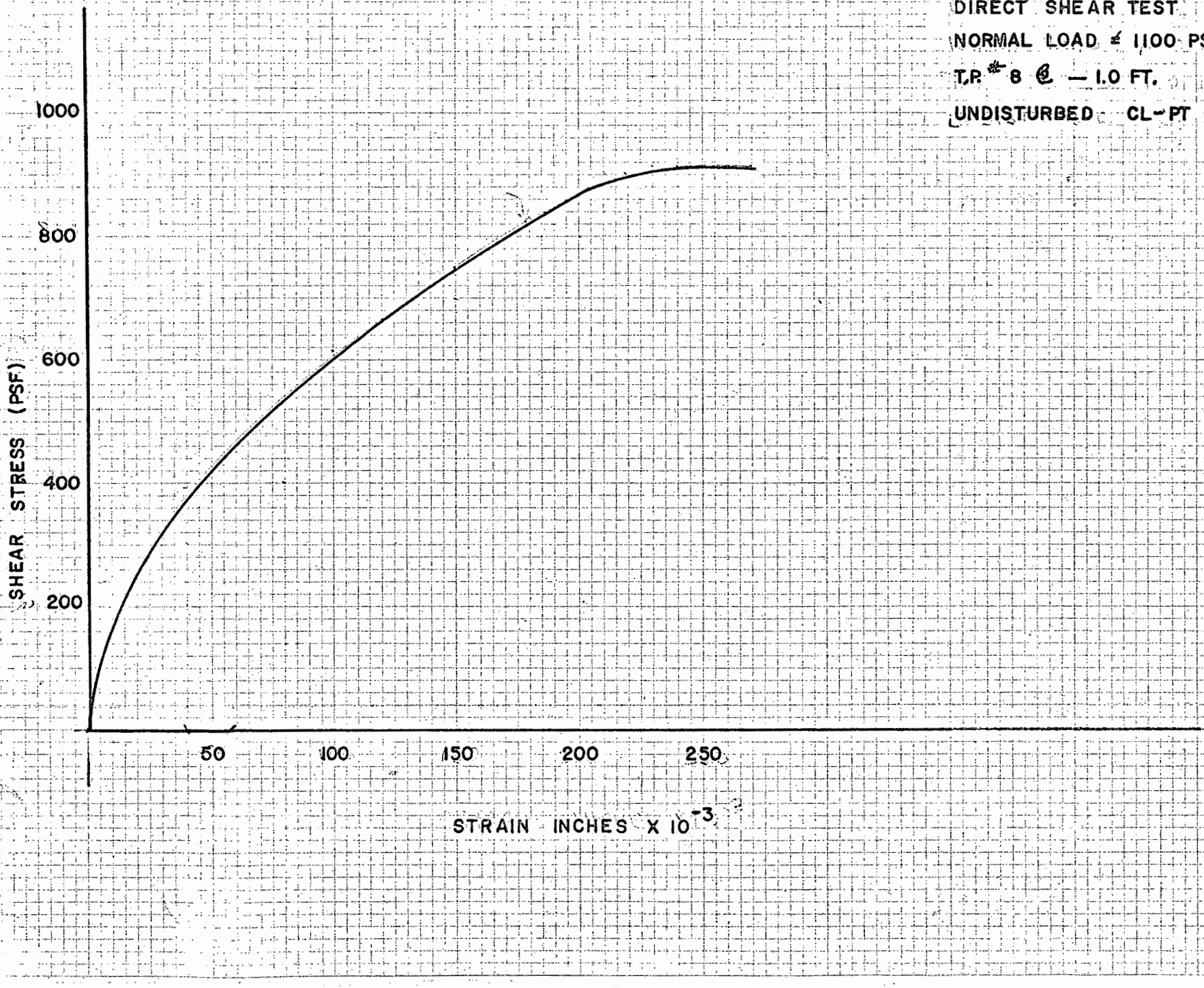
PT #2

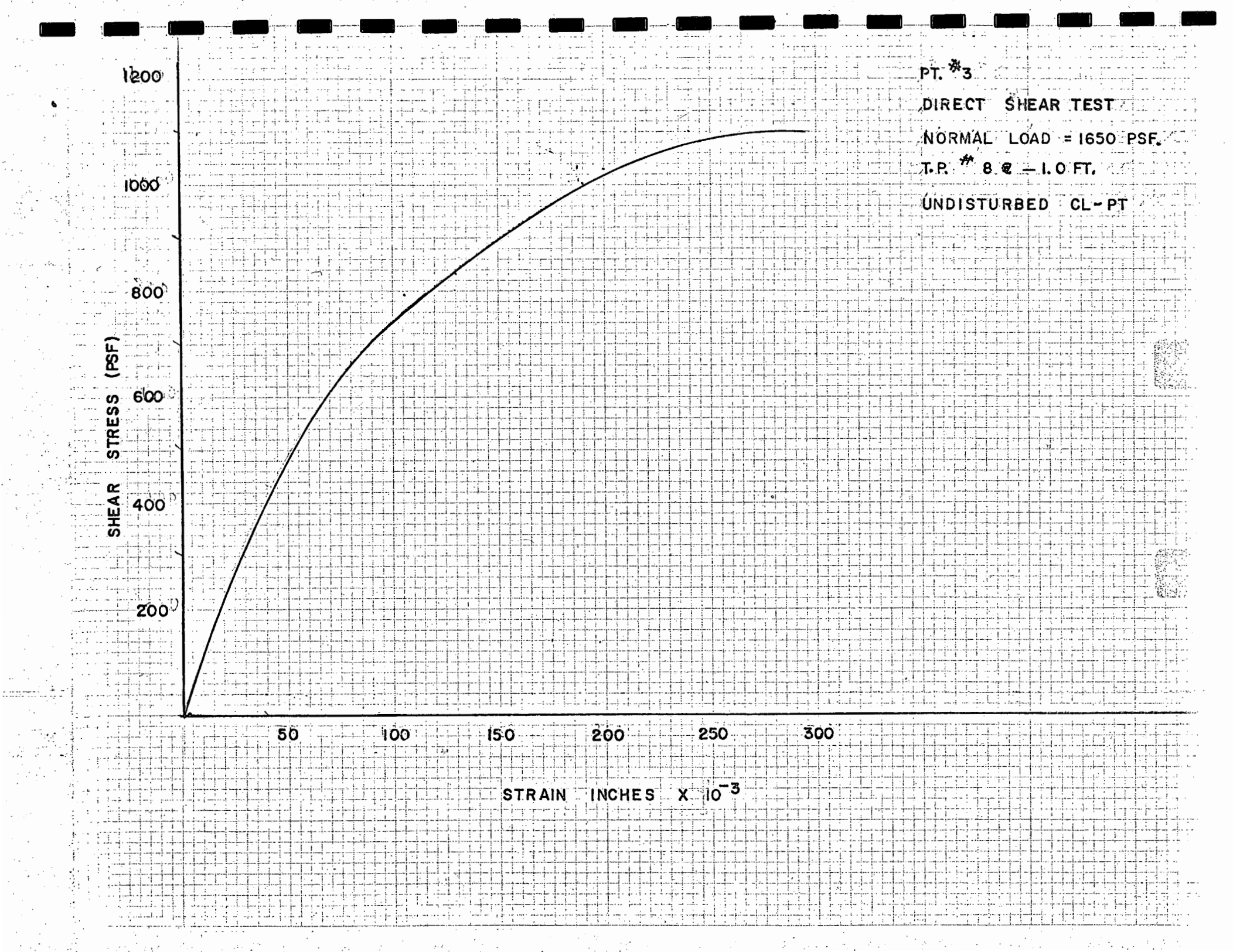
DIRECT SHEAR TEST

NORMAL LOAD = 1100 PSF

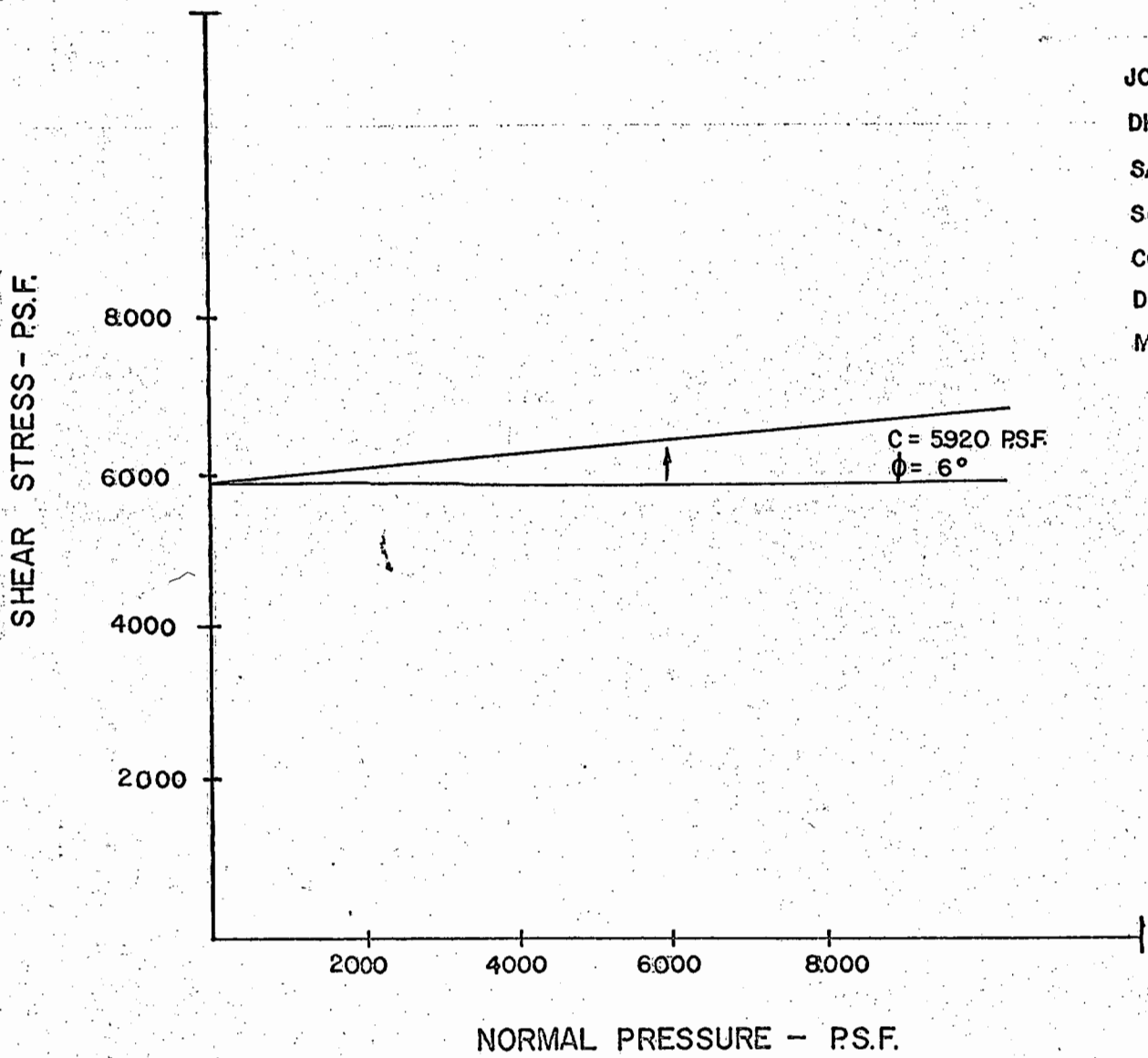
T.P. # 8 @ — 1.0 FT.

UNDISTURBED CL-PT




PT. #3
DIRECT SHEAR TEST
NORMAL LOAD = 1650 PSF.
T.P. # 8 @ — 1.0 FT.
UNDISTURBED CL-PT
SHEAR STRESS (PSF)
1200
1000
800
600
400
200
50
100
150
200
250
300
STRAIN INCHES X 10^{-3}

DIRECT SHEAR TEST



JOB No. 192

DH/TP No. 11

SAMPLE DEPTH - 3'

SOIL TYPE MH

CONDITION UNDISTURBED

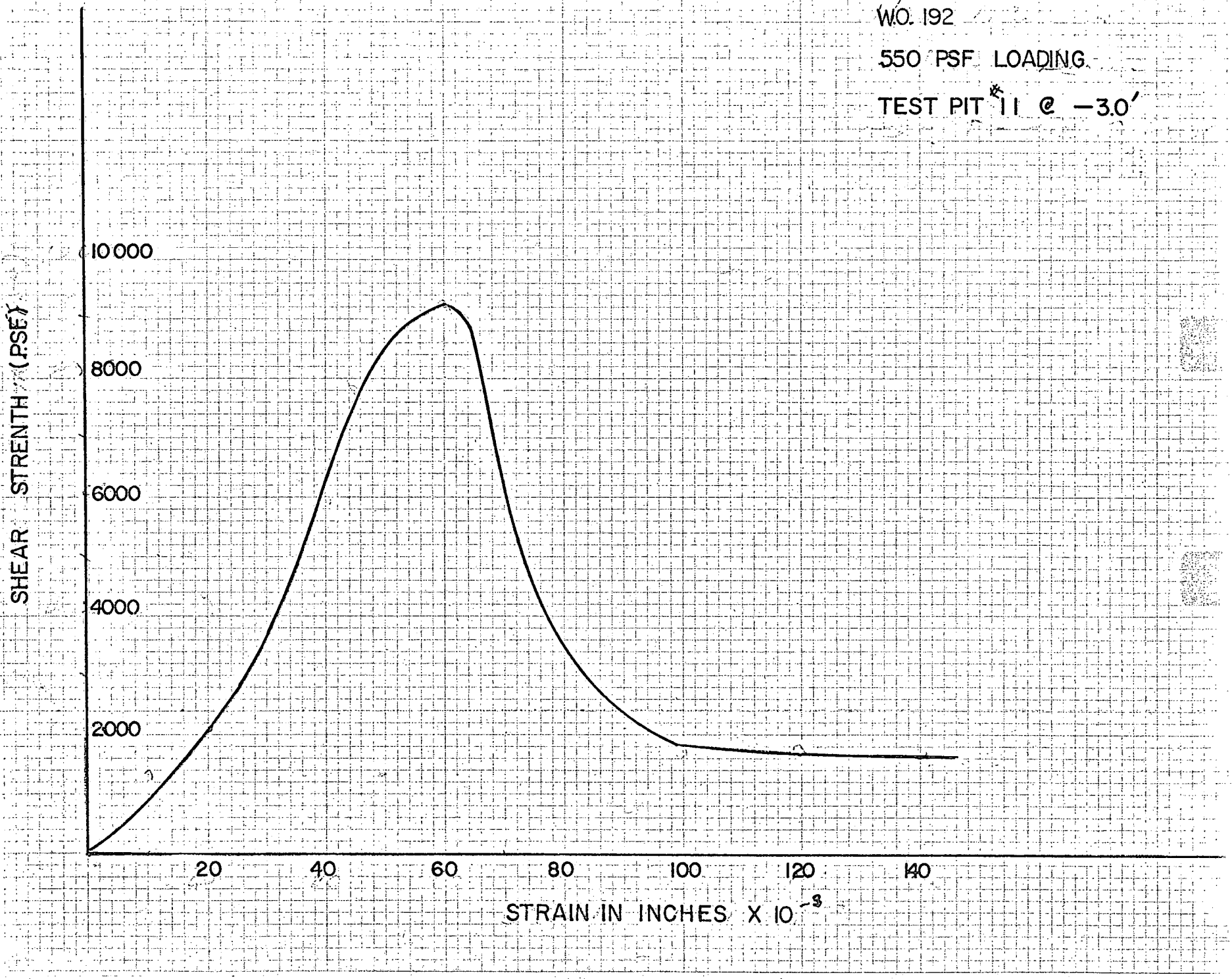
DRY UNIT WT. 89.7 P.C.F.

MOISTURE 21.5%

W.O. 192

550 PSF LOADING

TEST PIT #11 @ -3.0'



W. O. 192

GRAVEL SPECIFICATIONS FOR SCHOOL SITE AREA

(Percentage Passing by Weight)

Sieve Size	Rock and Limestone	Filler
2"	100	----
1 - 1/2"	90 - 100	----
3/4"	50 - 90	----
1/2"	----	100
3/8"	----	90 - 100
#4	25 - 50	----
#8	----	25 - 45
#100	----	10 - 30
#200	3 - 9	----

EARTHWORK SPECIFICATIONS
KAOPA SUBDIVISION UNIT 2
KAILUA, HAWAII

The work under this section includes:

1. Clearing and grubbing of site
2. Preparation of natural ground
3. Preparation of fill areas
4. Placement and control of fill operations
5. Compaction equipment
6. Removal and backfill of underground structures
7. Supervision of earthwork
8. Seasonal requirements

1. Clearing

All areas within contract limit lines shall be cleared of trash, debris and organic matter, and such material shall be burned and removed from the site.

2. Preparation of Natural Ground

In areas where the bottom of footings are designed on or below existing natural ground, the soils shall be scarified to a depth as determined by the soils engineer until the material is free of all uneven features and shall be precompacted as outlined in the following Section #4b.

3. Preparation of Fill Areas

All areas upon which fill is to be placed after clearing, as outlined in Section #1 of these specifications, shall be scarified until free of uneven features to a depth as determined by the soils engineer, and watered and compacted according to Section #4 of these specifications.

4. Placement of Fill

a. Material for fill shall consist of on-site soils. Fill material shall be free of all organic matter and other deleterious material, and shall not contain rocks or lumps in excess of four inches (4") in diameter. Material for fill in the school site area shall conform to the specifications as shown in Appendix G.

b. Compaction of Fill

After the base for the fill has been prepared as described above, it shall be brought to the proper moisture content and compacted to not less than 90% of maximum density in accordance with the modified AASHO T-180-57.

c. Depth of Fill

Fill shall be placed in horizontal layers which, when compacted, will not exceed six inches (6").

5. Compaction Equipment

The soils engineer shall determine the type of compacting equipment which will attain the specified results in the most efficient manner. Sheepsfoot, vibratory, or pneumatic tire rollers may be used in the test section and the equipment which produces the specified results in the most expedient manner as determined by the soils engineer shall be employed by the contractor. The equipment used in rolling shall be in good working condition, fully ballasted, and self cleaning. Fill material placed in an unsatisfactory condition and not within the enclosed specifications shall be rejected by the soils engineer and the contractor shall rework the fill placed such that the specifications are followed.

6. Removal and Backfill of Underground Structures

Any underground structures such as cesspools, cisterns, septic tanks, wells, pipe lines, etc. shall be removed

under the direction of the soils engineer. Backfill of the excavation shall be in accordance with these specifications.

7. Supervision of Earthwork

Field density tests shall be made by the soils engineer during the earthwork operation such that he may certify that the fill was placed according to accepted specifications. In the event that field density tests of a layer or any portion thereof is less than the required density, the particular layer or portion shall be reworked until the required density is obtained.

8. Seasonal Requirements

No fill shall be placed during unfavorable weather conditions as determined by the soils engineer. After interruption of work due to heavy rain, the soils engineer shall approve previously placed fill before resumption of earthmoving operations.

BORING LOCATIONS

TEST PIT LOCATIONS

AREA LIMITS

FIGURE NO. 1.

HAMAKUA DRIVE

KEOLU DRIVE

ON PLAT

T E

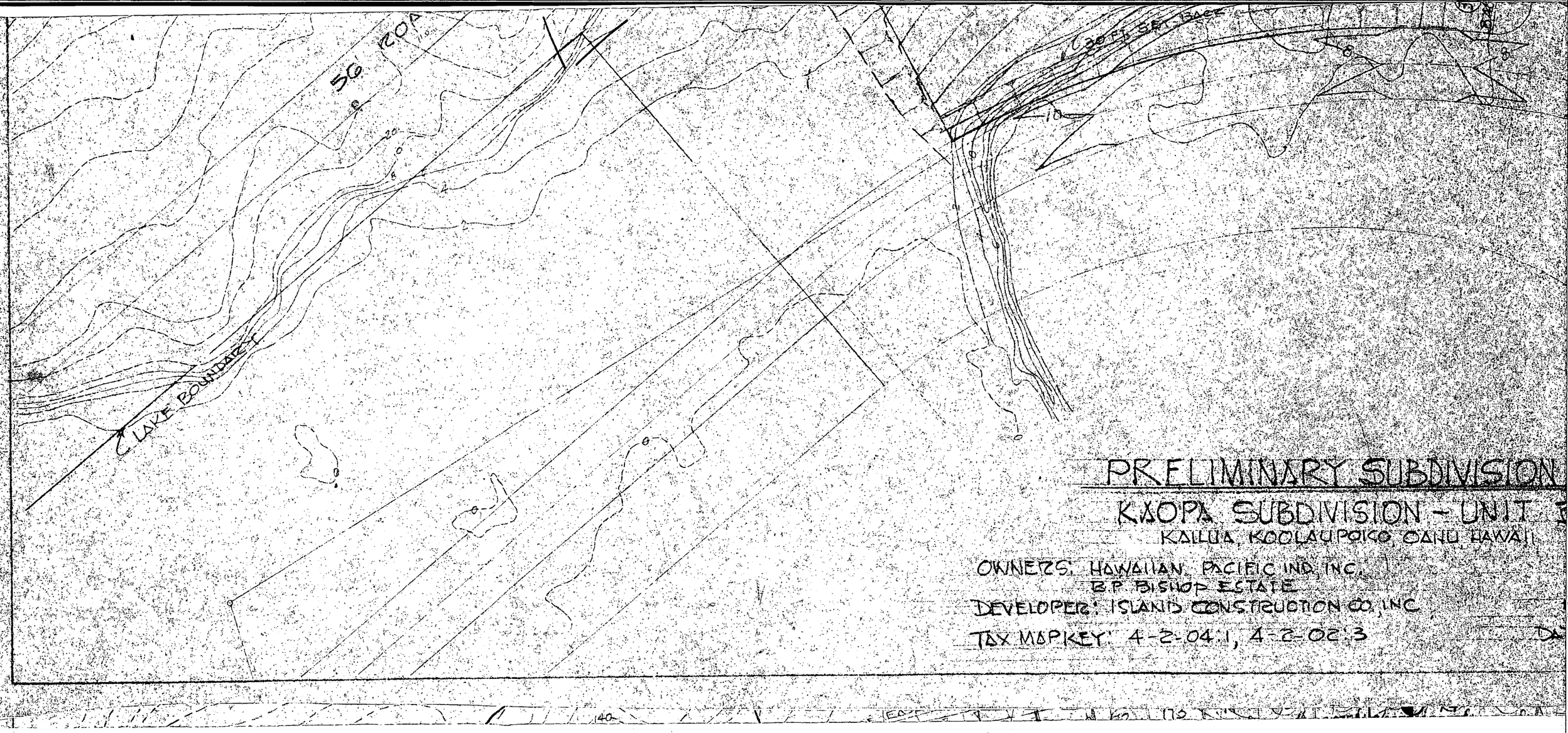
BY Y ARAKAKI

DATE MAY 4 1970

YASUO ARAKAKI
REGISTERED
PROFESSIONAL
ENGINEER
No. 654
HAWAII, U.S.A.

THE WORK WAS PREPARED BY
ME OR UNDER MY SUPERVISION

School Site



PRELIMINARY SUBDIVISION

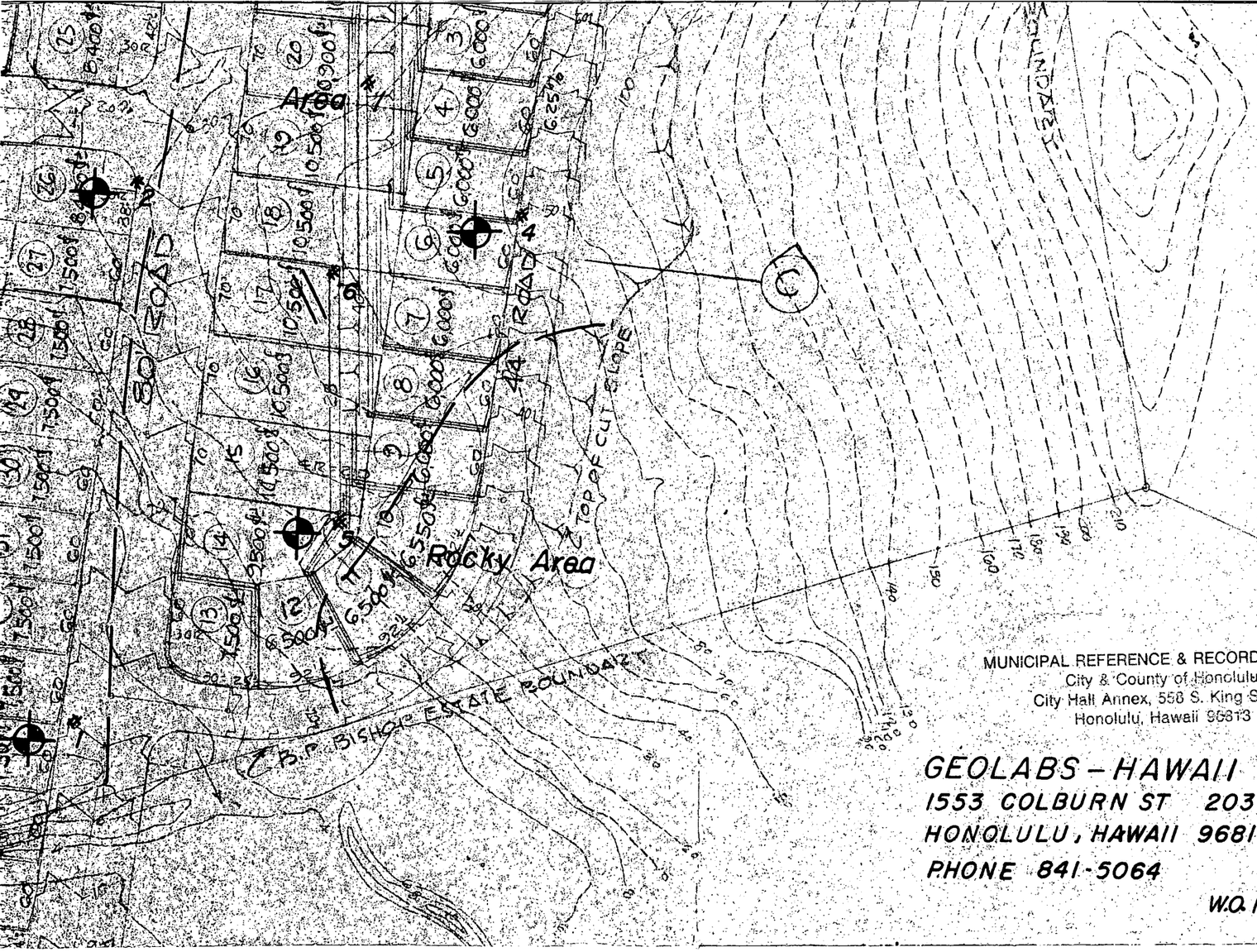
KAOPA SUBDIVISION - UNIT

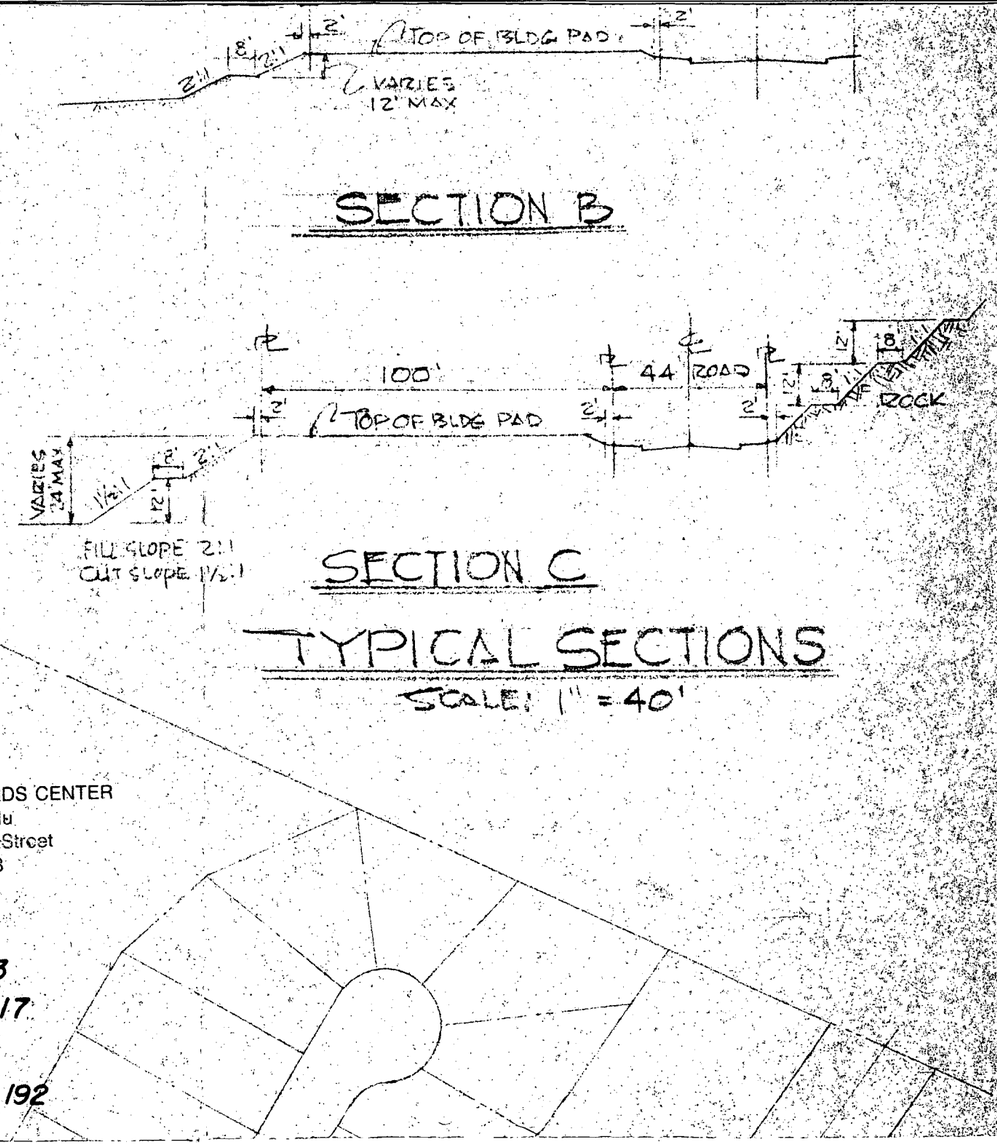
KAILUA, KOOLAUPOKO, OAHU, HAWAII

OWNERS: HAWAIIAN PACIFIC IND, INC.,
B.P. BISHOP ESTATE

DEVELOPER: ISLAND CONSTRUCTION CO, INC.

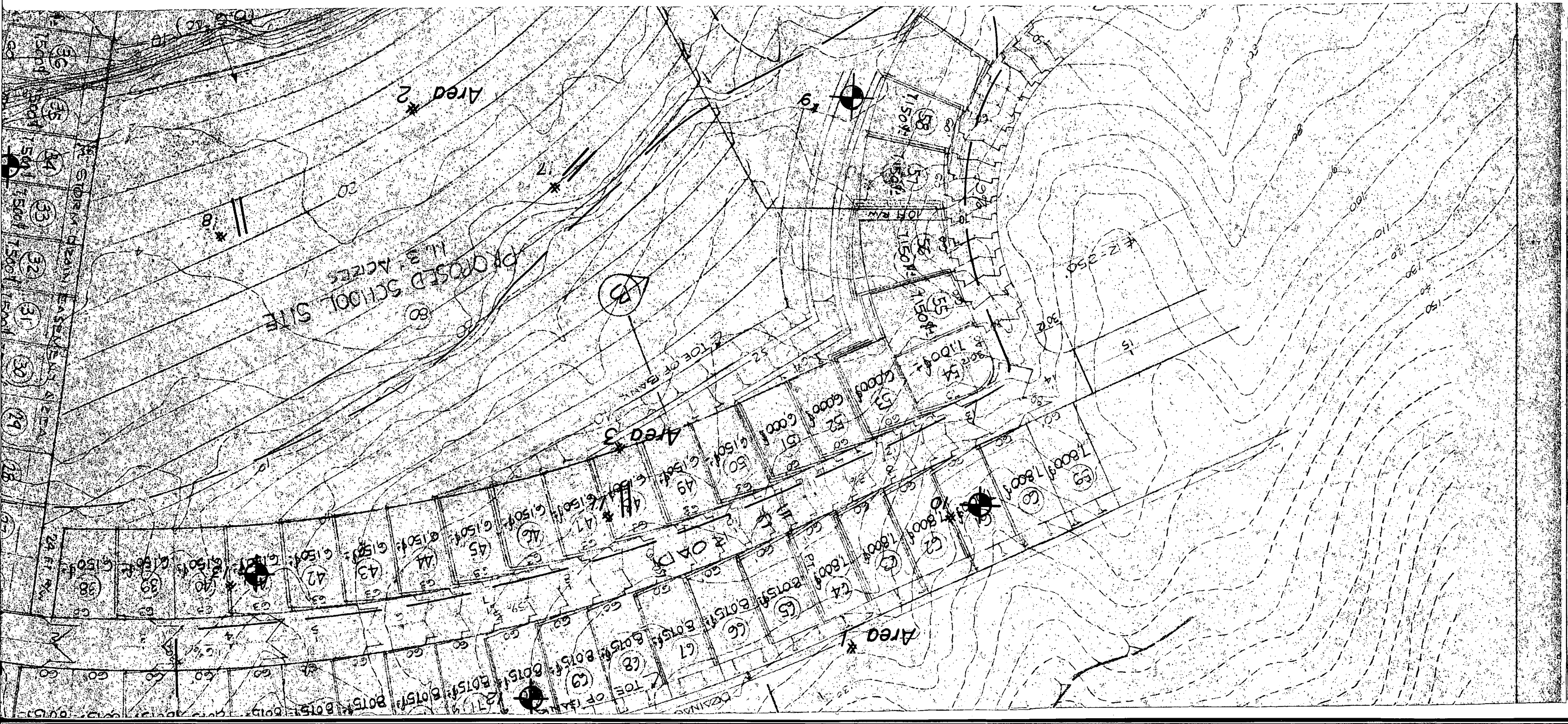
TAX MAP KEY: 4-2-04:1, 4-2-02:3





GEOLABS – HAWAII
1553 COLBURN ST 203
HONOLULU, HAWAII 96817
PHONE 841-5064

W.O. 192

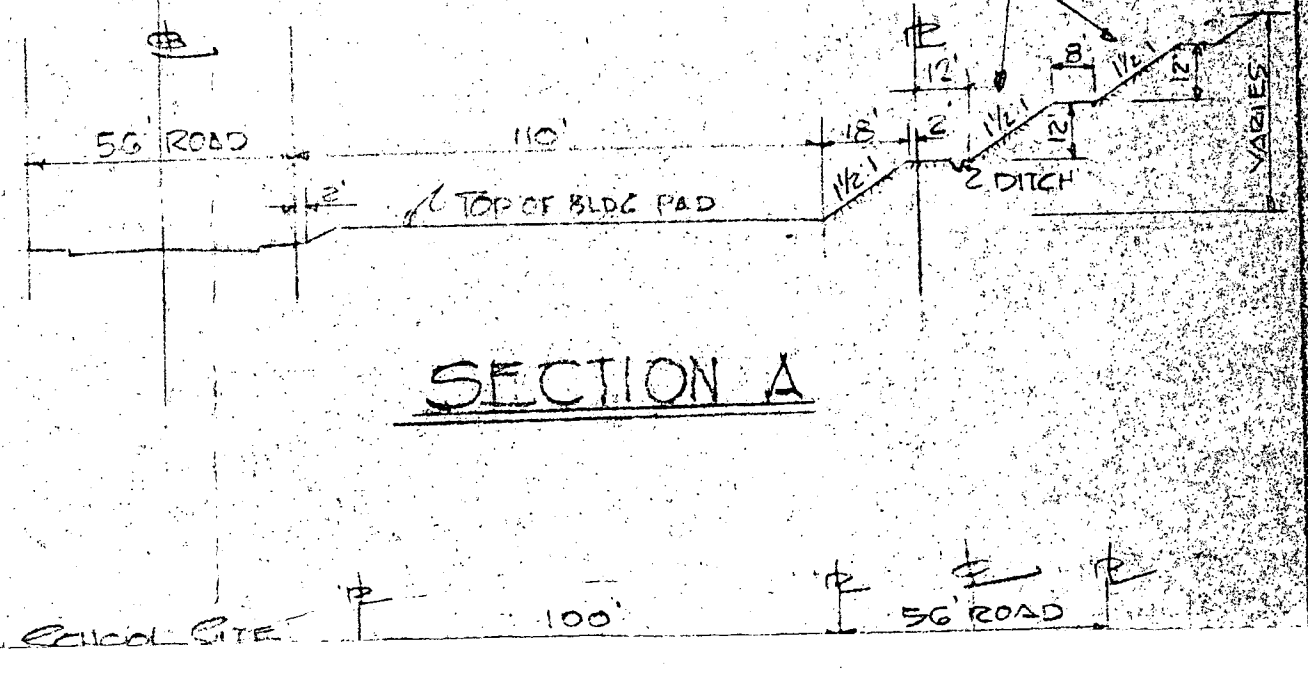

Area 1
Area 2
Area 3
PROPOSED SCHOOL SITE
11.3 ACRES
TOE OF BANK
TOP OF BANK
OAK
ELM
ASH
ROAD
EASEMENT
DRAINAGE
30' R/W
10' R/W
B0T5ft
7,800sf
7,200sf
6,000sf
6,150sf
6,150sf
6,300sf
6,450sf
6,600sf
6,750sf
6,900sf
7,050sf
7,200sf
7,350sf
7,500sf
7,650sf
7,800sf
7,950sf
8,100sf
8,250sf
8,400sf
8,550sf
8,700sf
8,850sf
9,000sf
9,150sf
9,300sf
9,450sf
9,600sf
9,750sf
9,900sf
10,050sf
10,200sf
10,350sf
10,500sf
10,650sf
10,800sf
10,950sf
11,100sf
11,250sf
11,400sf
11,550sf
11,700sf
11,850sf
12,000sf
12,150sf
12,300sf
12,450sf
12,600sf
12,750sf
12,900sf
13,050sf
13,200sf
13,350sf
13,500sf
13,650sf
13,800sf
13,950sf
14,100sf
14,250sf
14,400sf
14,550sf
14,700sf
14,850sf
15,000sf

BORING LOCATIONS

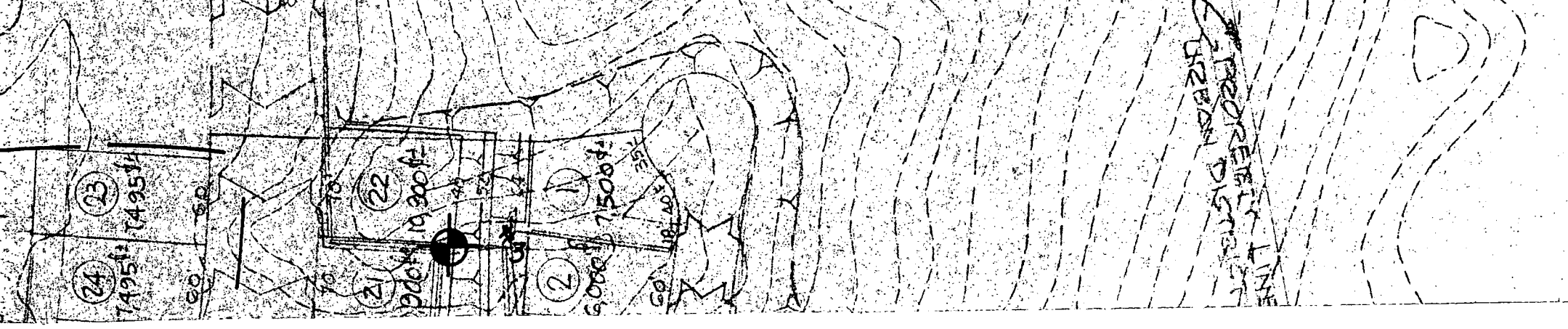
TRUE NORTH

Scale: 1 in = 100 ft.

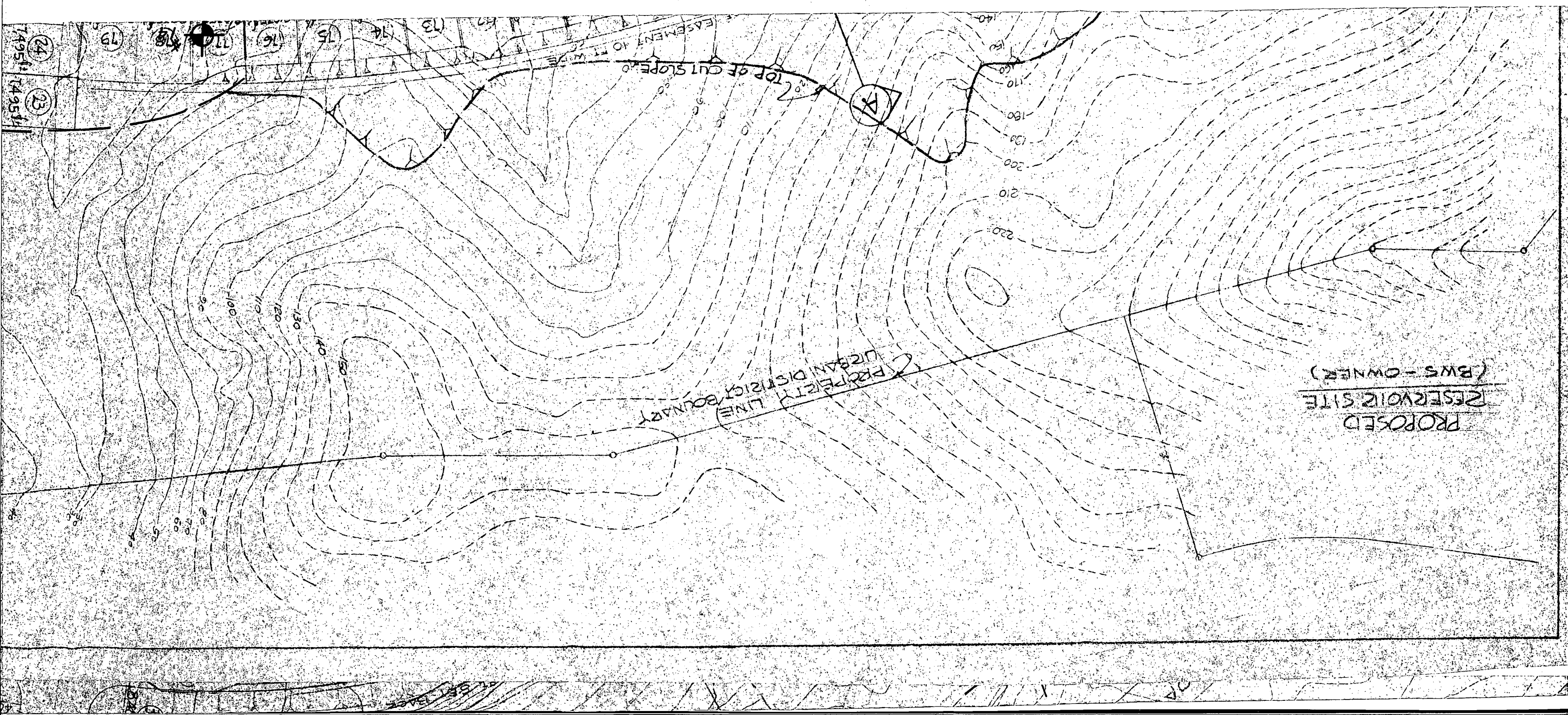
NOTE:
CUT SLOPES IN ROCK MAY BE STEEPER AS PER SOILS ENGINEER RECOMMENDATIONS



SECTION A



CIVIL SITE 100' 56' ROAD


PROPOSED
RESERVOIR SITE
(BWS - OWNER)
PROPERTY LINE
URBAN DISTRICT BOUNDARY
TOP OF CUT SLOPE
EASEMENT 10 FT WIDE
79
78
77
76
75
74
73
24
23
1495
1495
140
150
160
170
180
190
200
210
220
100
110
120
130
140
150